THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 43. Thursday, November 20, 1930. No. 744.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (4 lines).

Contents.

	PAGE
Forthcoming Events	349
Weldings	349
International Trading Facilities	349
London Junior Foundrymen Meet	350
British Machine Tools for Russia	350
I.B.F. Branch-Presidents	350
Catalogue Received	350
Random Shots	350
Note on the Influence of Superheating Molten Cast Iron	351
Marine-Engine Castings	352
The Production and Applications of High Nickel, Nickel-Copper Alloys and Pure Nickel	353
Members' Foundry Problems to be Discussed ...	354
The Annealing of Foundry Hooks and Chains ...	355
Some Thoughts on Modern Foundry Developments	357
French Phosphoric Pig-Iron Syndicate	359
Iron and Steel Output in October	359
Mechanical Properties of Nickel Steel at Elevated Temperatures	360
Applications for Trade Marks	360
Cupola Practice in the Malleable Iron Foundry...	361
Patent Specifications Accepted	362
Surface Hardening	362
New Steelworks in Pretoria	362
The Aluminium Development Competition... ...	363
Publication Received	363
Trade Talk	364
Company Meeting	364
Iron and Steel Markets	366

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1930-31:
F. P. Wilson, J.P.,
"Parkhurst," Middlesbrough.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham: F. K. Neath, 24, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, 26, Castlewood Road, Fulwood, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: W. Gilpin, "Sunnyside," Birch Grove, Rusholme, Manchester.
London: Dr. A. B. Everest, Mond Nickel Company, Limited, Imperial Chemical House, Millbank, London, S.W.1.
Newcastle-upon-Tyne: F. Sanderson, 15, Handyside Arcade, Newcaste-upon-Tyne.
East Midlands: H. Bunting, 82, Otter Street, Derby.
West Riding of Yorkshire Branch: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth Branch: J. J. McClelland, 19, Windsor Place, Cardiff.
Middlesbrough: F. A. Harper, "The Briars," Bishopton Road, Stockton-on-Tees.

Foundry Trades Equipment and Supplies Association.

President: A. S. Beech,
13 to 15, Wilson Street, London, E.C.2.

Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION.
The Registered Office and Laboratories of the B.C.I.R.A. are at:—
24, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1895. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk *(Telephone 339).*

Forthcoming Events.

NOVEMBER 24.

Institution of Mechanical Engineers (Graduates' Section):—Ordinary meeting in London. "Machine Tools," Paper by C. H. Russell.

Institute of British Foundrymen.

NOVEMBER 21.

Lancashire Branch (Junior Section):—Ordinary meeting. "The Art of Brass Founding," Paper by F. W. Rowe, B.Sc.

NOVEMBER 24.

Birmingham, Coventry and West Midlands Branch:—Visit to works in Coventry. Lecture on "Apprentice Training" by A. E. Barriman.

NOVEMBER 29.

Newcastle-upon-Tyne and District Branch:—Visit to works of Bede Metal & Chemical Company, Limited. Lecture on "Iron Foundry Refractories, with Special Reference to Moulding Sands," by J. G. A. Skerl, D.Sc.

Wales and Monmouth Branch:—Ordinary meeting at Bristol. "Jobbing Moulding and its relation to the Engineer," Paper by S. Southcott.

Weldings.

Welded steel structures, which an authority has recently suggested should be called "weldings," just as cast metal structures are called castings, originated in America, where what might be termed jobbing castings and one-off jobs are not easy to obtain. We learn that the large electrical corporations there that swung over so heavily to weldings have found the pendulum swing too far, and are reverting in a number of lines to castings. We hear of a welding boy being converted to a foundry and of some lines which have been produced by welding going back to casting.

This bears out our contention from the beginning, but we should not be doing our duty to the industry if we did not encourage founders to study this matter and endeavour to meet welding as a legitimate competitor. The industry cannot afford to lose tonnage, and it has to meet the situation on its own. The blast furnaces as a whole are not affected. They will sell more basic and hematite and less foundry pig, but the foundries are greatly concerned. The casting has many things in its favour. Compared with weldings, a casting is a homogeneous, rigid structure of attractive appearance. A welding is not, but the job is lighter, anything from a third to a half. Wherever speed is concerned, whether of construction or operation, lightness counts.

The foundry industry may be content to let the one-off jobs go to the welder with a sigh of relief, but the competition is keen. For mass production the foundry has it easily, but welding will improve in speed and operations in skill. Metallurgists will no doubt be asked to study the job.

We advise founders not to be content to let an engineer specify intricacies and frills in a casting that he would be prepared to go without in a welding. The question of designing parts for foundry mass production to be welded together afterwards should also be considered. If welding is good in the boiler shop, tank shop or engineering shop, it is good in the foundry.

We have previously drawn attention to American and German experience, that there is little difference in cost between a casting and a welding for the same job. In a large works the costing system may make it difficult to arrive at a true figure in the two cases. A series of figures has recently been published giving the costs of castings and weldings for nine different jobs. Only in two cases was the welding cheaper, the difference in one case being 0.07 pence per lb. and in the other 0.29 pence per lb. On the other hand, the dearest welding was nearly double the corresponding casting, the costs here being 3.66 pence per lb. for the casting and 6.3 pence per lb. for the welding.

If welding is really more economical and satisfactory, it is really trying to stem the tide to stop it, particularly as the large works will use either department without prejudice. But we do want to see the founding industry use all the weapons at its command to make sure that the casting is in the best possible condition to meet the competition. At present we are by no means sure.

International Trading Facilities.

The characteristic feature of the post-war decade is "Safety first," and probably its most interesting phase is that of its application to international trading. The two greatest bugbears in this connection are financing export orders and the settling of any disputes that may arise. Both these factors have been tackled since the war, and it can truthfully be said that never since international trading began were conditions easier for the entrant. Obviously, old-established exporting houses know exactly with whom they are dealing, and are in a position privately to ascertain the worth of any new account opened.

For an order received by a British firm from a virtually unknown foreign house, conditions for its transacting are facile. The question of credit is handled by the Department of Overseas Trade, 35, Old Queen Street, London, who, by the way, have just issued free a handy guide to the services they provide. The question of disputes arising under the contract of sale and purchase has been resolved by the International Chamber of Commerce, 38, Cours Albert 1er Paris 8. Both parties must agree to the following clause: "*All disputes arising in connection with the present contract shall be settled under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the Rules.*"

Normally, the arbitrator belongs to neither of the nationalities seeking an award, whilst an examination of the costs incurred in typical cases so far dealt with are, from a British "legal" point of view, ridiculously small. The clause quoted has been translated into French, German, Italian and Spanish by the Chamber and thus mistakes as to the import of its significance when inserted in two languages is hardly likely to be questioned.

Having personally transacted a fair volume of international business, we appreciate to the full the facilities now available, especially to the small trader embarking on an export business.

London Junior Foundrymen Meet.

The London Junior Section of the Institute of British Foundrymen held its opening meeting of the session in the offices of The Foundry Trade Journal, 49, Wellington Street, W.C.2, on October 31.

Miss M. D. Pittuck (Chairman) presided, and opened the meeting with an address entitled "The Work of an Agricultural Research Station." She commenced with a short historical review of the subject, describing how agricultural research commenced 88 years ago, when plants were first analysed to see why they grew. Various things, such as nitrogen, phosphate, etc., were then added in order to try to get larger plants. From that time agricultural research has advanced steadily until the present day, when there is a very elaborate system for the testing of fertilisers.

The utilisation of the crops when grown was a matter for the biochemist. It was he who had to decide whether the crop grown with the new fertiliser was more digestible or otherwise than the crop grown with the old fertiliser. Investigations are also being carried out into the possibility of artificially drying young grass at an economic cost, in order to make it into briquettes, nuts, etc., for the winter. Many forms of drier are being tried for handling the fresh grass, and careful records kept to ascertain whether artificial grass drying could be made an economical proposition. Investigations into numerous other agricultural problems were being carried out, and the success of the work meant a great deal to the prosperity of this country and the Dominions.

The remainder of the evening was devoted to a short Paper on the Wadkin Universal pattern-making machine, by Mr. F. C. Cummings.

British Machine Tools for Russia.

The following joint statement was issued last Monday by Mr. S. G. Bron, Trade Representative of the U.S.S.R. in Great Britain, Bush House, Aldwych, and Mr. Greville Maginness, chairman of the Associated British Machine Tool Makers, Limited, 17, Grosvenor Gardens, London, S.W.1.

We have to-day signed a general agreement which provides placing by the Trade Delegation of the U.S.S.R. in Great Britain through its agents, Messrs. Arcos, Limited, orders for different kinds of machine tools to an amount of £600,000 during the year ending October 31, 1931. The association extends to the Trade Delegation credit to the full amount of the orders placed and undertakes to provide the Soviet industry with technical assistance in construction of machine tool-making works in the U.S.S.R. The agreement provides for an extension of trade in the future.

The placing of orders under this agreement will be commenced at once. Mr. Maginness, accompanied by other directors of the Associated British Machine Tool Makers, will proceed to Moscow at the beginning of next week in order to establish a personal contact between the British machine tool-making industry and the respective industrial and trading organisations of the U.S.S.R.

Saul G. Bron.
G. S. Maginness.

The Duffield Iron Corporation, Limited, states that certain mechanical defects in the company's plant have now been obviated, and a test of the retort for iron production resulted in a recovery of up to 81.46 per cent. as metallic iron of the total iron contained in the ore. By modifications now proceeding the company expects to increase the recovery to above 90 per cent.

I.B.F. Branch-Presidents.

No. 2.—MIDDLESBROUGH BRANCH.

Mr. W. Shaw, who is managing director of Messrs. W. Shaw & Company, Limited, of the Wellington Cast Steel Foundry, Middlesbrough, was educated at the Bishop Auckland Grammar School. He served his apprenticeship at Messrs. Charles Attwood's Stanners Close Steelworks, Wolsingham, Co. Durham. It was here in 1862 that his father, the late Mr. W. Shaw, built and successfully worked the first open-hearth steel furnace, with a capacity of 15 tons, from drawings supplied by C. W. Siemens. This furnace was designed originally for glass making. Mr. Shaw saw eight of these furnaces tapped simultaneously, and the whole of the steel was poured into the mould of the cradle of the famous 81-ton gun.

In 1892 Mr. Shaw's father started the Wellington Cast Steel Foundry, at Middlesbrough,

Mr. W. Shaw.

working a similar furnace and the same process as that mentioned above. The history of the firm has been one of steady progress, and many large and important contracts have been executed to Admiralty, War Office, Lloyds and other inspection. It has been associated with the Institute of British Foundrymen as a subscribing firm since 1922.

Catalogue Received.

Pickling Machines.—Messrs. Taylor & Sons, Limited, of Briton Ferry, South Wales, have sent us an advance copy of the new catalogue illustrating and describing the New Taylor Minor pickling machine. The machine automatically deals with castings, forgings, tinplates, including the pickling, neutralising and washing, and the returning of the cradles to a point remote from the machine for reloading. Adequate provision is given for the taking away of the fumes, whilst the exceptionally long experience of the company—over fifty years—has enabled them to provide long-life materials and the best of working conditions. Though castings are given the pride of place on the title page, we should have liked to see some data as to its cost as compared with sand-blasting. We have noticed that where foundries have adopted pickling they seldom, if ever, discard the process.

Random Shots.

Few stories are more remarkable among present-day happenings than that of the meteorite that fell in Northern Siberia. The fall actually took place in June, 1908, and the flashes and thunder of its fall were heard, even in that sparsely-populated region, by tens of thousands of people. Rumours of the devastation got about, but it was not until 1921 that a small expedition left Leningrad to investigate the matter. A second expedition was necessary, and this went in 1927, and progress to the crater was made at the rate of four miles a day on skis and with reindeer. Round the craters the primeval forest had been blasted, leaving the ground bare.

* * *

The craters were ten to fifty yards diameter and about four yards deep. The temperature of the gaseous blast on impact is estimated at over 1,000 deg. C. The weight of the meteorites is estimated to be over 130 tons, and fragments consist of iron and nickel, with a little platinum. The area devastated amounts to over a thousand square miles, for wild life ceased with the vegetation. We should not have had to wait over twenty years to hear of an event of this kind had the meteorite struck the earth a little farther west and desolated a square tract of country having a side, for instance, as long as the distance from London to Luton.

* * *

If somebody in Fleet Street wants to make a little money quickly I suggest that they start a daily newspaper exclusively for Americans. I hear that they complain bitterly that to get the gist of the American news at present they have to buy an English paper published in Paris.

* * *

The remarks made recently by the Canadian Prime Minister remind me that British manufacturers should find a happy hunting ground in Canada since the passing of the Dunning budget, which gives preference to a number of articles. The budget arose out of Canadian resentment at the American tariff bill, but owing to obstructive delays to the latter (every newspaper in the country was against it) the Dunning budget was actually passed first.

* * *

A recent journal gives some amusing illustrations of flying slang, and recent tragedies have brought home again the peculiar difficulties and risks of the airman. A "Chinese ace" as a man who has made a Chinese landing—Wun Wing Low. The "floor" is not the ground, but the stratum of rarefied upper air in which a plane can hardly fly. To "fly on the floor" is to fly as high as possible for the load carried. A careless and complaining pilot talking about engine, weather or wing trouble is said to have pilot trouble. A poor sort of pilot is known as a Kiwi, the New Zealand bird with atrophied wings which merely help it to run but not to fly. A reckless stunter is a hedge-hopper or a dizzy pilot.

* * *

I hear that some of the most exciting flying scenes ever filmed are to be seen in a new talking film at the London Pavilion. These include the bombing of London by a Zeppelin and its attack and ultimate destruction in flames by British aeroplanes, the bombing of a German ammunition dump, and a fight between British and German planes in which about fifty machines take part. The film cost a million pounds and seven lives.

Marksman.

Note on the Influence of Superheating Molten Cast Iron.

By J. E. Hurst.

The experimental investigation of the influence of melting temperature on the properties of cast iron has been extended into the high-temperature regions. Piwowarsky, Bardenheuer and their collaborators in Germany have published the results of their experiments, and the attention of foundry metallurgists has been drawn to what has now come to be known as superheated cast iron. The writer has had the opportunity of making some experiments with a view to investigating the effect of superheating molten cast iron on its physical and mechanical properties.

The experiments have been made with castings produced by the centrifugal process. The metal for the production of these castings is maintained in an oil-fired receiver. A quantity of this metal, about 50 lbs., was poured from this receiver into a Morgan-Salamander crucible and transferred to a crucible-melting furnace of the

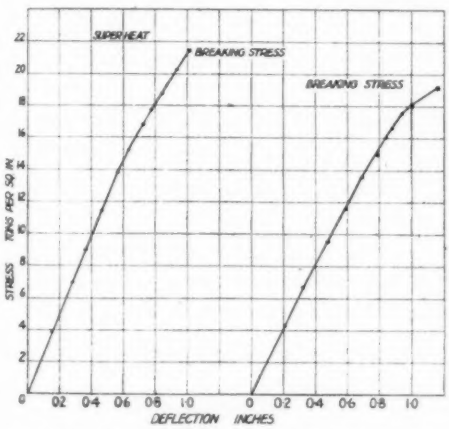

FIG. 1.—STRESS-DEFLECTION CURVES FROM "SUPERHEATED" (LEFT) AND "NORMAL" (RIGHT) CENTRIFUGALLY-CAST IRON GAPPED RINGS.

Morgan type, designed for melting steel. This metal was raised to as high a temperature as possible, and whilst it was not found possible to measure the temperature attained with any semblance of accuracy, it can be described as equal to that of molten steel, containing about 0.35 per cent. carbon, in a condition suitable for casting. Approximately this may be said to be from 1,550 deg. to 1,600 deg. C., and for the purposes of this note this temperature value has been assumed to have been attained.

The metal, superheated in this manner, was made up into cylindrical test castings on one of the centrifugal-casting machines. For comparison purposes similar castings were made from the same metal taken from the oil-fired receiver prior to superheating. The temperature of this metal direct from the oil-fired receiver was about 1,250 deg. C.

It will be understood that the castings made by the centrifugal process are produced in metal moulds, and precautions were taken to ensure that the conditions of spinning speed and mould temperature were identical in both cases. It is also of importance to emphasise that these two factors can be controlled with a considerable amount of accuracy. The finished castings after examination were cut up into test-rings. The whole of the strength tests were carried out on test-rings machined up in accordance with the requirements of the British Engineering Standards Association specification for aircraft material. 4.K.6. A number of experiments carried out in the above manner have been made. The results in each case have been identical. It will serve, therefore, to give the complete results taken from one experiment. The description of the results will be simplified by referring to the two sets of comparative tests under the titles of "Normal" and "Superheated" material, the melting temperatures of the "Normal" and "Superheated" being respectively 1,200 to 1,250 deg. C. and 1,550 to 1,600 deg. C.

Examination of the Castings.

The "Normal" castings were normal in every respect, possessing the characteristic surface and fracture of centrifugally-cast material. The "Superheated" castings were badly pinholed on the external surface. Very little difference could be observed in the appearance of the fracture from that of the normal material. If anything, the "Superheated" material showed a slightly duller and blacker fracture, with slightly more tendency towards "openness" towards the inside surface.

Chemical Composition.

The analyses of samples taken from both materials are as follow:—

	"NORMAL."	"SUPERHEATED."
	Per cent.	Per cent.
Total carbon ..	3.27	3.14
Comb. carbon ..	0.70	0.70
Graphite	2.57	2.44
Silicon	1.92	1.55
Manganese ..	0.83	0.87
Sulphur	0.085	0.087
Phosphorus ..	0.62	0.62
Chromium ..	Nil	Nil

Strength Tests.

Determinations of the tensile strength, modulus of elasticity (En value) and the stress-deflection curves were made on rings cut from the sample castings. The results are as follow:—

	"NORMAL."	"SUPERHEATED."
	lbs. per sq.in.	lbs. per sq. in.
Modulus of elasticity (En)	17.9×10^6	18.7×10^6
	17.8×10^6	18.2×10^6
	tons per sq.in.	tons per sq.in.
Tensile strength	19.2	21.5

The stress-deflection curves are illustrated in Fig. 1. These curves are obtained by plotting the increment in gap opening with the stress obtained by stressing the gapped rings. The area included by these stress/deflection curves is proportional to the energy required in breaking the specimens and is used as an index of the brittleness. The areas of the normal and superheated curves at the original scale of plotting have been measured with a planimeter and are 31.3 and 19.3 sq. in. respectively. The stress-deflection curves are plotted from readings taken from a recond loading of the test-pieces. During this test the permanent set value is obtained. This is measured during the first loading of the specimens in the following manner. The total extension in the diameter of the ring across which the stress is applied is measured at a stress value of 14 tons per sq. in. The stress is then removed and the permanent extension of the diameter is then measured. This permanent extension in the diameter, expressed as a percentage of the total extension in diameter at the stress value of 14 tons per sq. in. is used as a measure of the permanent set. The values obtained on the two samples are as follow:—

Permanent Set "Normal Material," 12.3 per cent.

Permanent Set "Superheated Material," 10.4 per cent.

In preparing the specimens for test, it is usual to observe the behaviour of the material during the cutting of the gap. The superheated material closed slightly on sawing the gap, whilst the normal material opened slightly. This indicates the presence of internal stresses in the material, but the distribution of the stresses is different in the two samples.

Brinell Hardness.

The Brinell hardness determined across the radial thickness of the samples, using a 2-mm. ball and a load of 120 kg., are given below:—

	"NORMAL MATERIAL."	"SUPERHEATED MATERIAL."
Outside edge ..	235	255
	248	269
	241	255
	248	255
	255	241
	241	262
	241	255
	241	248
Inside edge ..	235	241
Mean value ..	243	253

Consideration of the Results.

The effect of superheating by means of coke firing in a crucible on the properties of a sample of cast iron has been examined. It has been found that certain slight changes in properties have been brought about by superheating. The tensile strength, stiffness as indicated by the modulus of elasticity (En value) and Brinell hardness, are slightly higher in the superheated material. The permanent set value and the stress/deflection value of the superheated material are lower than the normal material. Produced under the conditions of these experiments, the superheated material is liable to extensive unsoundness.

It is of importance to note the loss in silicon content undergone by the superheated material, which is lower than the normal material to the extent of 0.4 per cent. This difference in silicon content is somewhat remarkable in view of the fact that the superheated material was quite freely machinable and without sign of chill. Material of a composition similar to that of the superheated material cast under normal conditions would almost certainly show extensive chill on the outside surfaces adjacent to the spinning moulds. This being the case it appears quite certain that in these experiments the effect of superheating has been towards the production of a greyer iron.

The New "Cresta" Electrode.—The new "Cresta" electrode, made by Alloy Welding Processes, Limited, marks a great advance, as a remarkable elongation has been obtained in tests of welds made with it. In 12 test pieces the elongation obtained between points 1 in. apart, *i.e.*, covering the weld metal, the elongation never fell below 33 per cent., and reached as high a figure as 36 per cent. This elongation was gained with an entire absence of porosity. The tensile strength was 27 to 28 tons. An electrode is now available which can be used safely for the welding of pressure vessels produced by electric-arc welding. Theoretically the perfect weld should possess characteristics equal in every respect to the metal being welded, *i.e.*, the tensile strength should be the same, the ductility should be the same, the resistance to fatigue should be similar, and the chemical composition should not vary; but having obtained the theoretically perfect electrode, one has then to consider the fact that the metal deposited is in theory a casting, which has not been subjected to the refining action of the "working," resulting from the heating and rolling operations.

Marine-Engine Castings.

A DISCUSSION ON DIESEL-ENGINE FOUNDRY PRACTICE

At a meeting of the Newcastle Branch of the Institute of British Foundrymen, held on October 25, Mr. W. Scott read his Paper on "The Production of Large- and Medium-Sized High-Class Iron Castings."* This was followed by a short cinematograph film showing moulding machines in actual operation. In reply to a query as to whether it was possible to do any fine moulding work on the foundry floor when a jolt-ramming machine was being used, Mr. Scott pointed out that the modern machine had been specially designed to overcome that difficulty. The machine in question incorporated two sections of hard wood and in between a layer of cord. It was quite reasonable to do moulding within eight feet without any harm being done whatever. That was on a concrete floor, and the jar was inclined to be spread more than normally. There would be no effect six feet away with a sand floor.

Drying of Oil-Sand Cores.

Mr. V. Stobie asked for the composition of the metal used for the piston-skirt tube, which contracted on repeated heatings, as it was generally the case that expansion, and not contraction, took place. For oil-sand cores Mr. Scott said that he used dirty parts of sea sand to one of linseed oil. At what temperature did he effect drying?

Mr. Scott replied that the iron used for the piston-skirt tube was only ordinary-grade iron, and the only reason that contraction instead of expansion took place was that in that particular part a hot spot was formed. The oil-sand cores were dried at about 150 to 175 deg. C. He believed in drying them with plenty of hot air rather than at a higher temperature.

Mr. Shaw remarked that Mr. Scott had cast quite a large head on the piston skirt, and the metal down the side of the piston was relatively thin to the boss on the upper end. Was there any trouble through drawing? It looked rather as if there was a chill.

Mr. Scott said that no chill had been used, and that no trouble had been experienced. He did not think the big head was essential, it could be cut down, but they had found that 8 in. of head gave good results, therefore they had kept to that size.

Why Coremaking Time was Reduced.

Mr. C. Gresty referred to the column in which the pattern had been blocked out on the bottom side, and asked whether they were to understand that, although this blocking out involved more coremaking, the coremaking cost was lower. Thus, before blocking out, the coremaking time was given as 140 hours and afterwards as 130 hours. He would like Mr. Scott to give an explanation of that point.

Mr. Scott replied that these times were taken from actual wages office records, and had not been specially selected. There had actually been a saving, and he attributed it mainly to a psychological reason—the fact that the change had resulted in a considerable drop in moulding time, and the coremakers had worked harder to keep up with the moulders.

Composition and Machinability.

Mr. W. J. Paulin said he had noticed in the sand mill Mr. Scott had spoken of the taper on the rollers. It might have been an optical illusion, but to him it had not seemed as if the taper would meet on the shaft itself. He took it that the bottom of the pin would be perfectly horizontal. Mr. Scott had mentioned that in some heavy castings the silicon was about 1.8 per cent., and it had struck him that with such heavy castings they would get considerable porosity in machining. Did that occur? Mr. Scott had mentioned that they used refined iron for some of those castings—iron of known analysis. Were there any changes in the second melting? Were they actually better after the second melting, as was generally understood? He had noticed that there was a marked difference in the silicon in the first castings as compared with that in the piston skirt, where the silicon was 0.8 as against 1.8 per cent. in the first case. He thought that they must have had considerable difficulty in machining that. Did they not get a sort of annealing process through the very hot core being left in?

Mr. Scott said that the taper on the roller actually did meet at the centre. All the taper was on the top side, as was shown in the illustration. With regard to the silicon in heavy castings, 1.8 per cent. was used in turbine and Diesel castings. That was a point he had stressed. The castings were useless if there was any porosity. The thickness varied; it was about 1¾ in. when the silicon was 1.8 per cent. As the thickness increased the silicon was reduced. There were various reasons for the use of refined iron, the greatest from the practical point of view was the guaranteed analysis. If a foundry was making an important casting and could not afford the services of a metallurgist, then the use of refined iron simplified matters. On the other hand, the iron was good iron. Used in proportion with suitable pig-iron, and in some cases a small addition of steel, it could be made to meet any requirements one wished. If the customer required low silicon, steel was added to keep down the total carbon and silicon. A liner containing 0.8 per cent. silicon could not be machined at the same rate in feet per minute as a bedplate. When a definite Brinell test was demanded, there could be no grumbling because the iron was hard to machine. With regard to the annealing effect, the liner was not easy to machine; it did not need special tools, but the speed of machining was reduced. A certain amount of annealing took place, but the liner was taken out of the furnace after about 24 hours, and it was very hot when it was taken out. With regard to the pipe core, he had only shown that illustration in order to let them see to what extent their competitors in America had gone. They poured the pipe with about 16 runners with a ladle which was practically as long as the pipe and which had 16 lips on it.

Solving the Heavy Scrap Difficulty.

Mr. T. B. MacBride asked if the tensile strength of 14 tons which Mr. Scott had told them had been obtained in connection with the turbine cylinders had been from bars attached to the casting or cast separately. The large piece of scrap from the head of the Diesel-engine jacket, which would be about 18 in. high and about 6 or 7 in. thick, would be difficult to dispose of.

Mr. Scott said that the test-bars were cast on. They had a fairly low total carbon, in some cases they had reached about 3 per cent. The head on the jacket had been found to be rather a problem, but as a rule they had broken it into four pieces. They had now a new idea; they were going to insert a core about ¾ in. or 1 in. thick in about five places around the head. It would not interfere with the feeding possibilities, and it would break more easily than a solid head.

Mr. A. D. Kirby said he had always understood that the lowest temperature suitable to dry oil-sand cores was 250 deg. C., but Mr. Scott had mentioned that he dried them at 150 to 175 deg. C.

Mr. Scott replied that those were the temperatures at which they worked, and he thought they were quite in order so long as one had large volumes of hot air, that was the whole secret. Perfectly satisfactory results were obtained at that temperature, and the oil in the cores was thoroughly oxidised. They were put in a green-sand bed and left in for twenty-four hours, and the surface could not be scraped off with the thumb-nail.

Cores Preferred to Drawbacks.

Mr. Shaw referred to Mr. Scott's remarks concerning the blocking out of the pattern of the Diesel engine core, and to the opinion that he had given that in future all patterns would be blocked out and that plainer designs of castings would be used. Mr. Scott had not made it very clear whether he meant that the designs would actually be plainer or whether they would be made plainer by blocking out. It seemed to him that a better job could always be made with cores than with drawbacks.

Mr. Scott replied that he had really meant both ways. It would never be possible to eliminate all projections on the outside of castings. The development was towards plainer castings, and the outside projections would be reduced to a minimum. He had had rather a lot of criticism about quoting times in his Paper, but the reason that he had done so was that during the last two years he had been able to go to the Continent several times, and he was getting rather concerned about the position in England in the engineering world. They had to pull together and share their knowledge, and he put the times in his Paper with the permission of his directors. In the case of the steel-foundry industry, castings were coming into the country cheaper than they could be produced, despite the carriage. It was only by all of them telling each other their vital secrets, one might say, that they would have a chance to compete with manufacturers on the Continent. His Paper had been written with the sole intention of giving away some secrets so that others would be encouraged to tell some of theirs.

Sand Consumption.

Mr. Gresty said that he had been rather surprised at the amount of new sand which Mr. Scott had said he used. Floor sand 75 per cent. and new loam 25 per cent. were the quantities he had mentioned. He wondered whether Mr. Scott had any figures showing the amount of new sand used in comparison with the output in the foundry. He had been very interested recently in data of that type from different foundries. As Mr. Scott said that they were constantly using new sand, the proportion of new sand must be very great. Their own proportions were 1 ton of sand for every 3 tons of castings, covering the whole output of the foundry.

Mr. Scott replied that the figures he had been quoting had, of course, referred to a heavy class of casting; they were different on the lighter side of the foundry, the percentage being more like 12½ per cent. It was varied according to the class of goods, generally being 33 per cent. of loam to 66 per cent. of old sand, but on smaller classes of work it dropped considerably. Their sand consumption was not so good as Mr. Gresty's figures. They used about 10 cwts. of sand per ton of castings delivered. They were, however, heavy users of oil sand, which was not reclaimed in any way. Some weeks they used as much as 50 tons of oil sand per week.

Mr. Stobie proposed a vote of thanks to Mr. Scott, which was seconded by Mr. F. Allan, and to which Mr. Scott briefly replied.

Special meetings of the 7 per cent. cumulative preference shareholders and of the ordinary shareholders in Tube Investments, Limited, passed resolutions to increase the capital of the company with the object of creating an alliance with Messrs. Stewarts & Lloyds, Limited.

* See Issue of August 7, 1930, p. 91.

The Production and Applications of High Nickel, Nickel-Copper Alloys and Pure Nickel.*

By N. C. Marples, B.Sc.

Nickel-copper alloys were known at least as early as the 3rd century, B.C., when one of this family of alloys was used in coinage. It was not, however, until the year 1751 that metallic nickel was discovered and isolated. While the early history of the nickel-copper alloys and of pure nickel is in itself a most interesting study, engineers and metallurgists will doubtless prefer to consider the extent to which these materials now penetrate into the various fields of industry.

It has been established that highest mechanical properties in Ni-Cu alloys are obtained from those alloys whose nickel content lies between 60 and 80 per cent., with an optimum at about 65 per cent. nickel. It is also found that corrosion resistance over a wide range of industrial conditions is at a maximum for the same composition. Therefore, in discussing the nickel-copper alloys high in nickel, one is considering what, from a general engineering utility standpoint, are the most important of this series.

Monel Metal.

From the viewpoint of consumption, this group of alloys has to-day one outstanding representative, namely, "Monel metal"—a nickel-copper alloy which contains approximately two-thirds of nickel and one-third of copper. This alloy may in a sense be termed a natural one, since it is smelted direct from nickel-copper ores. The ores, originally worked as a source of pure nickel, contain approximately:—Copper, 1 to 2; nickel, 3 to 4; iron, 40; silica, 25; sulphur, 20; and alumina, magnesia and lime, 10 per cent. Though the total nickel-copper content is thus only about 5 per cent., the relatively large amount of copper made the separation of either pure nickel or pure copper both difficult and expensive. It was therefore decided in 1905 to smelt out the two metals simultaneously and to examine the commercial merits of the resulting alloy. Investigation at the time showed the alloy to be superior to pure nickel, not only in its resistance to the corrosive action of many mediums, but also in its mechanical properties. It provides, therefore, an alloy proportioned by nature, practically coincident in composition with the optimum nickel-copper ratio since ascertained by research. This fact, combined with the present-day wide applications of Monel metal, justifies the considering of this alloy as the outstanding representative of the high-nickel, nickel-copper alloys.

Turning now for a moment to pure nickel itself, one finds that it is applied in three main forms:—(*a*) As an addition element in ferrous and non-ferrous alloys; (*b*) as anodes for plating; and (*c*) as malleable nickel in the form of rod, sheet, strip, wire, tubing, etc. In these three forms it has, at the present day, a minimum nickel content of 99 per cent.

As an alloying element, nickel finds by far its widest application; thus we have structural and automobile nickel steels, the Austenitic stainless steels, nickel-silver, *i.e.*, the copper-nickel-zinc alloys, nickel-chromium heat-resisting alloys, nickel-iron alloys notable for their high permeability, nickel cast iron employed where maximum hardness combined with machinability and freedom from "chilling" is required, nickel-brass and bronzes utilised where greater hardness and corrosion resistance as compared with straight brass or bronze is desired, coinage alloys, and nickel-copper alloys ranging from cupro-nickel with 20 to 30 per cent. nickel, on the one hand, to alloys such as Monel metal on the other.

Next in importance are the anodes for plating. This application, old-established as it is, has of late years undergone very considerable expansion as a result of the development of heavy plating methods and of the necessity for nickel as an under metal in chromium plating.

In the malleable form the uses of nickel are necessarily limited by the fact that it is in direct competition with its various alloys, which offer advantages either on the score of price, ease of working, strength, electrical properties or some other factor. It has, however, certain distinct applications, for example, in wireless valves, in food-handling equipment, in photographic apparatus and in chemical plant where particular qualities are desired. Such applications are dealt with later in this Paper.

Data.

Monel metal is produced, and used, at the rate of about 1,400 tons per month, or about 17,000 tons per annum. The world production of nickel during 1929, including that contained in Monel metal, was of the order of 50,000 tons. Statistics of the applications of nickel in various forms in the United States of America, during the year 1925, showed that over 50 per cent. was used in the manufacture of alloy steels, principally the structural and automobile nickel steels, while the remainder was equally divided between consumption for nickel silver, coinage and plating, and consumption for general purposes, *i.e.*, the other alloyed forms and malleable nickel itself.

Physical Properties.

Coming now to a detailed consideration of physical properties, one finds that those of Monel metal are what one would expect from a typical solid-solution alloy. Its microstructure resembles that of a pure metal, and there can, therefore, be no selective attack under corrosive conditions. Since the alloy is a solid solution it cannot respond to thermal treatment like a carbon steel, but it behaves like a pure metal or like other solid-solution alloys such as, say, ordinary 70/30 brass. Increased tensile strength and hardness can, therefore, be induced only by cold-working operations such as drawing or rolling.

From the point of view of mechanical properties Monel metal stands high, and even in the annealed condition it is considerably stronger than mild steel. In the normal hot-rolled condition it has an ultimate tensile strength in excess of 34 tons per sq. in., some bars ranging considerably higher than this if they are finished rather cold in the hot mill.

Monel metal is characteristically tough, and retains this toughness even after severe cold working. This fact is illustrated in the Izod impact tests carried out on metal which has been subject to cold reductions of 15 per cent. and 26½ per cent. respectively. The former, with an ultimate tensile of 42 tons per sq. in. absorbed 110 ft.-lbs.; the latter, with an ultimate tensile strength of 53 tons per sq. in. and a yield of 51 tons per sq. in., absorbed 86 ft.-lbs. In both cases the specimens have remained unbroken.

The mechanical properties of Monel metal are capable of being very greatly enhanced by cold work, and, as already noted when considering toughness, this cold working can be done without any danger of rendering the metal brittle. Monel metal is, for example, widely employed for propeller shafts of speed boats. These are utilised in the form of cold-drawn rod to the following specification:—Ultimate tensile strength, 40 to 45 tons per sq. in.; yield point, 35 to 38 tons per sq. in.; proportionality limit, 28 to 30 tons per sq. in., and elongation, 20 per cent. on $4\sqrt{\text{area}}$.

A common failing with bronze shafts is that even when excessively heavy shafts are employed in speed boats, they whip and cause the whole craft to vibrate. With Monel-metal shafts of the characteristics just outlined all danger of whipping is eliminated, and some engine builders now practically insist that Monel-metal shafts be used with their engines, so as to ensure complete absence of vibration, which might otherwise be attributed to their engines being improperly balanced.

The high proportionality limit in these shafts is achieved by cold drawing the shafts from a predetermined size of annealed rod, after which the drawn rods are "strain annealed." This "strain anneal" takes the form of a low-temperature heat-treatment carried out at around 290 deg. C. This treatment is particularly beneficial in removing the excessive strains induced during the cold-drawing operation. If, for example, the skin of a drawn shaft which has not been so treated is broken by machining a keyway, or some such operation, the tendency will be for that shaft to warp badly. After the low-temperature heat-treatment, keyways and the like can be machined in the shaft without any danger of warpage. In the "as-drawn" condition the shafts would have a proportionality limit of possibly 16 to 20 tons per sq. in., and the mere warming up of the shafts to 290 deg. C. for 30 minutes or so has the rather surprising effect of increasing the proportionality limit to over 30 tons per sq. in.

Air Compressors.

Other applications of this cold-worked hard strain-annealed material include disc- and plate-valves for air compressors, as well as springs which have to operate under corrosive conditions or high steam temperatures. For spring wire much heavier cold reductions are possible than in the case of heavy rods, and therefore a tensile strength of over 60 tons per sq. in., with corresponding higher yield point and proportionality limit, are aimed at.

In common with most other high-nickel alloys, Monel metal retains a remarkable amount of its initial tensile strength within the range of temperatures employed in superheated steam practice. Monel metal is not seriously weakened at 400 deg. C., whilst steel has already started to fall away, and bronze and gunmetal have entered their plastic range. It is, of course, these characteristics which have led to the extensive adoption of Monel metal for such parts as turbine blades operating under high superheats, as well as for valve seats and spindles controlling steam at 400 deg. C. The physical properties of pure nickel are very similar to those of Monel metal in corresponding forms, but the tensile properties of the metal are about 10 per cent. lower than those of the alloy.

So far, physical properties only have been mentioned, and it will be appreciated that if these were all that the high-nickel, nickel-copper alloys had to offer, these alloys would not occupy the high places they do in industry. Nickel-copper alloys are primarily, however, corrosion-resisting materials, and before passing on to a description of their main fields of application it may be of interest to consider the characteristics which such alloys should possess in order to meet modern commercial requirements.

Corrosion Resistance.

From the industrial standpoint, corrosion resistance alone is rarely demanded of a material. In addition, some other property such as hardness, strength at normal or elevated temperatures, resistance to erosion, durability under ordinary works usage and, above all, amenability to working and fabricating operations is called for. Unless the last-mentioned property is present the applications of any alloy are very circumscribed indeed.

* Abstracted from a Paper read before the Scottish Local Section of the Institute of Metals, at Glasgow, on November 10.

Monel metal and nickel are not sensibly corroded by the elements, and they are unaffected by sea and estuarine waters even in tropical countries. They are impervious to the action of alkalies, are but little affected by ammonia, and, excluding nitric acid and sulphuric acid, offer very useful resistance to acids generally at the concentrations and strengths commonly found in industry.

The industrial user of corrosion-resisting material frequently asks for a definite "Yes" or "No" to the question, "Will the material resist a certain acid or chemical?" It is, however, seldom, if ever, possible to give a direct answer. Laboratory tests made with pure chemicals serve only for general guidance on performance under actual working conditions where, in addition to the effect of chemicals which are of only commercial purity, there are four principal variables each capable of entirely altering the rate of corrosion. These are: (1) Concentration of the corroding medium; (2) degree of aeration; (3) temperature, and (4) degree of agitation.

This aspect of the corrosion problem will be appreciated more fully if reference is made to the very detailed corrosion tests carried out by Messrs. Fraser, Ackerman & Sands.

The influence of acid concentration on the corrosion of Monel metal with aerated sulphuric-acid solutions at room temperature is such that the corrosion rate rises to a maximum at 5 per cent. sulphuric acid, and thereafter falls steadily with increasing concentration of acid to a minimum at 81 per cent. concentration. Here the reaction ceases to be simply the formation of metallic sulphates plus water and changes to the production of a mixture of sulphides and sulphates leading to an increasing rate of corrosion at higher acid-concentrations.

The effect of aeration on the rate of corrosion with a 5 per cent. solution at room temperatures is to increase the speed rapidly with increasing aeration up to approximately 100 c.cs. of air per min. per litre of solution, after which increased aeration has but little effect. It should be stated that, without aeration, corrosion proceeds at the rate of 30 mg/dm²/day, whereas with 100 c.cs. of air per min. per litre, the rate of corrosion is five times as great as in the unaerated solution.

The effect of temperature, when 5 per cent. sulphuric acid is the corroding agent and the rate of aeration is 100 c.cs. of air per min. per litre of solution, is such that there is a decrease in rate above 70 deg. C., due to decreasing oxygen solubility in the solution.

So far as the influence of agitation on corrosion rate, using a 5 per cent. H_2SO_4 solution at room temperature with aeration at the rate of 100 c.cs. per min. per litre of solution is concerned, when the sample is stationary, corrosion is at the rate of about 100 mg/dm²/day, but when the specimen moving in the solution at a speed of 240 ft. per min. the corrosion rate increases by 3.75 times.

In practically every industrial corrosion problem several or all of these variables may be acting in greater or less degree. One can therefore appreciate how advisable it is to treat each corrosion problem on its own merits and to institute, whenever possible, tests under actual working conditions.

Applications of Monel Metal.

Turning now to industrial applications of Monel metal, while it is difficult to summarise the full range of uses, the chief fields of use, from a tonnage point of view, are: Land and marine power plants, textile dyeing, chemical plant and artificial silk making, and what may best be described as hotel and domestic hardware.

The effect of long periods of exposure of Monel metal to highly-superheated steam has been carefully investigated, as it is established that some alloys are subject to failure by accelerated corrosion fatigue. No evidence of such deterioration or embrittlement in commercial service has, however, come to light. As proof of this, a throttle governor valve from a Weir feed-pump, which operates with steam at from 750 to 800 deg. Fah., was withdrawn after 45,000 hrs.' service in the Dalmarnock Power Station (Glasgow), and the valve showed no trace of cutting action. The metal was in no way embrittled. A ring of ¼-in.-sq. section was trepanned from one flange and hammered flat. It withstood the test perfectly, and no sign of surface cracking was visible, even on the sharp edges. The spindle, which had originally been made from cold-drawn rod, showed after a test that the ultimate tensile strength was 43.9 tons per sq. in., the yield point 22.5 tons per sq. in. and the elongation on 4 $\sqrt{\text{area}}$, 42 per cent.

Turbine blading is a further important application. This follows from the almost complete immunity of the metal to the cutting action of superheated steam, its strength and toughness at high temperatures and the fact that it can be drawn to accurate profiles with sharp edges and smooth surfaces. At least 200 tons of blading running in some cases at peripheral speeds of 800 ft. per sec. have been fitted in European installations during the past few years, chiefly for high-pressure work under exacting conditions, the temperatures ranging up to 420 deg. C. A survey of the more important installations recently disclosed that, in turbines opened up after several years' service, Monel-metal blades were in an unimpaired condition. The ultimate fuel economy arising from blading which retains its original profile and smooth surface is obviously considerable. In this connection, the work of the Parsons Marine Steam Turbine Company may be cited, as, for example, on the "Beaver" class ships of the Canadian Pacific Steamships, Limited. In these ships the first three stages of blading are of Monel metal. Similar practice obtains in the "Duchess" boats of the same company, in the "Empress of Australia," the "King George V" and a considerable number of other vessels, including British and foreign warships.

Among the more recent large installations may be mentioned the turbines of the "Bremen." For the whole of the reaction blades on the rotors of these turbines over 20 tons of Monel metal were employed. Similar practice is being followed in the new Italian vessels "Rex" and "Duce."

Land Applications.

In land, as distinct from marine work, advantageous use of the strength and corrosion resistance of Monel metal is made outside the power house in fittings in electrical sub-stations and power-transmission lines. To obtain full advantage of its physical properties the bolts and nuts should be machined from cold-drawn hexagon rod and not formed by hot upsetting. Similarly, hinge pins can be made from cold-drawn round bar, with the additional advantage that they do not require to be machined, but can be produced simply by cutting off to required lengths.

The original adoption of Monel metal on power lines dates back to 1913, when it was specified for the insulator hangers and sub-station switchgear bolts in the Panama Canal zone, the humid, salt atmosphere demanding, in the opinion of the engineers, a material which would provide permanent and continual service unobtainable from galvanised steel or bronze. That their decision to use Monel metal was justified is indicated by the report of their maintenance engineer, thirteen years after the equipment was put to work. The durability of Monel metal, as evidenced by this report, naturally led to its more and more extensive adoption on other transmission lines for hinge bolts, cable-clamp bolts, bus-bar connectors, etc. For such parts several prominent public-service companies now specify "All bolts ½ in. dia. and under shall be Monel metal."

Turning now to applications in which resistance to the corrosive effects of acids and other chemicals is required, one of the main fields is the supply of pickling equipment for removing scale from sheets, castings, forgings, articles to be enamelled, etc. No less than 104 crates are used by Austin Motor Company, Limited, in a continuous-conveyor type of pickling plant. Some of these crates have now been in service for over three years, night and day, in contact with sulphuric acid under conditions in which aeration, temperature and agitation are all active and they show no signs of corrosion.

Cast Monel-metal pickling rafts are particularly interesting from the foundry point of view. The length of one casting was 8 ft. and its weight was about 5 cwts. The total contraction on this length in Monel metal is 2 in. To cope with this contraction was in itself an interesting foundry problem. Successful production was achieved by moulding the casting entirely in the top box, which rested on a dry-sand drag in the bottom box, so that the sand around the metal could be lifted off immediately the metal had set.

Considered generally, the only field in which pure nickel can claim definite superiority over the 65 per cent. nickel-copper alloy is for applications in which resistance to heat oxidation, as distinct from strength, at elevated temperatures is required. The approximate upper limit of temperature for continuous operation in oxidising atmospheres is 650 to 750 deg. C., while the corresponding figure for Monel metal is 500 deg. C. Nickel is, therefore, used to a certain extent for sparking-plug electrodes. A small addition of manganese is usually made for this and for other applications in which work at high temperature is involved.

Members' Foundry Problems to be Discussed.

The Scottish Branch of the Institute of British Foundrymen held the second meeting of the session in the Royal Technical College, Glasgow, on November 8. Mr. James Miller, the Branch-President, presided.

The Chairman said that before proceeding to introduce the author of the Paper, which was to be presented that evening, he wished to explain an arrangement which the branch council had made at their last meeting. The council felt that it was possible to make the meetings more helpful to many of the members who occasionally met with difficulties in their daily work. It had therefore been decided that at the end of each meeting a short time, say 20 or 30 min., should be set apart for the discussion of problems met with from day to day. Any one who had met with any difficulty would be at liberty to state it before the meeting, when a practical discussion could be made. It was hoped that in this way the meetings would be made more interesting and helpful to a large number of the members. In order to set the ball rolling he himself proposed to describe what had to him been a problem, although to some of them it might not appear a matter of difficulty, he would like to hear the views of the meeting. He would then explain his own solution.

The President, in introducing Mr. R. Liddle, said that he was to read a practical Paper on "The Moulding and Casting of Bronze Plates." It was a subject of which he himself was almost entirely ignorant, but hoped that at the end of the meeting he would be rather wiser.

Mr. Liddle then read his Paper, which will appear in our next issue.

Use of Chains and other Lifting Gear.—The Home Office has now issued a fifth edition of Safety Pamphlet No. 3, entitled as above. Copies (9d. net each) can be obtained from the Stationery Office, Adastral House, Kingsway, London, W.C.2.

The Annealing of Foundry Hooks and Chains.

By Wilfrid Dunkerley, M.Sc.

Owing to the fracture of a foundry-crane hook which had never been annealed, an opportunity was presented of entering into the question of the correct heat-treatment of hooks, chains and other lifting tackle. The fracture of the hook was highly crystalline and was caused by fatigue strains. The method in use for removing such strains consisted in heating the chains, etc., up to 700 deg. C. for two or three hours, then allowing them to cool in the furnace. The purpose of this inquiry was to determine whether or not this treatment was correct.

Cathcart* describes in detail experiments designed to prove that the above low-temperature annealing is incorrect and that a temperature of 950 to 1,000 deg. C. should be used to obtain the toughest condition and the finest structure. Experiments similar to Cathcart's were carried out, by the author, on highly-strained chain links. A length of chain was used which had been alternately used and annealed several times. The chain was cut into lengths of two links each, and each length was tested separately in the following conditions: (1) As received; (2) heated at 700 deg. C. for two hours and cooled in furnace; (3) as (2), but followed by heating at 950 deg. C. for a few minutes, and (4) heating at 950 deg. C. for a few minutes and cooled freely in air.

Each pair was then broken on a tensile-testing machine. Each link of the pair was held by passing a short steel bolt through the link itself and through holes in special chucks. Fig. 5 shows the photographs of the links after fracture, also of the steel bolts used to hold the third and fourth pairs of links in the machine. The results were as follow: Pair No. (1), breaking load, 5,800 lbs., with a coarsely-crystalline fracture; Pair No. (2), breaking load 6,770 lbs., with a dark-coloured, poor fibrous fracture; Pair No. (3), breaking load 10,640 lbs., with a fibrous fracture and approximately 10 per cent. elongation; Pair No. (4), breaking load 9,100 lbs., with a fibrous fracture and approximately 7 per cent. elongation.

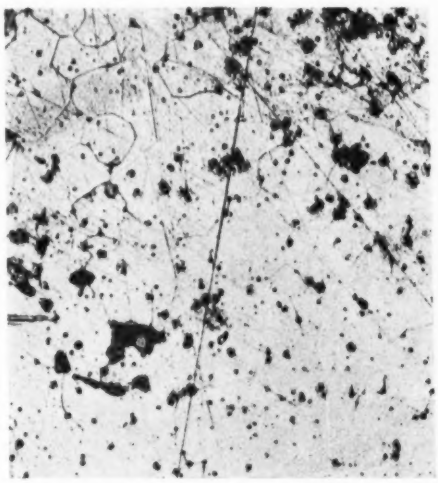

FIG. 1.—CHAIN LINK; NO TREATMENT.

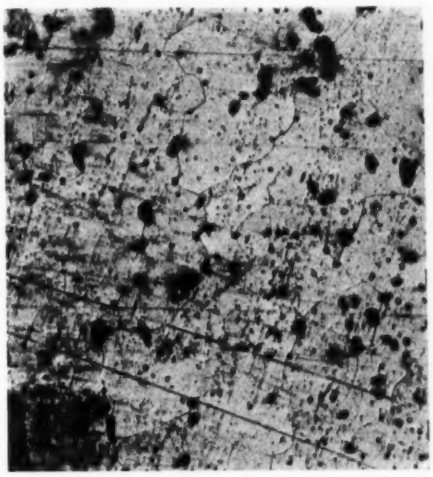

FIG. 2.—CHAIN LINK; HEATED TO 700 DEG. C. FOR 2 HRS. AND COOLED IN FURNACE.

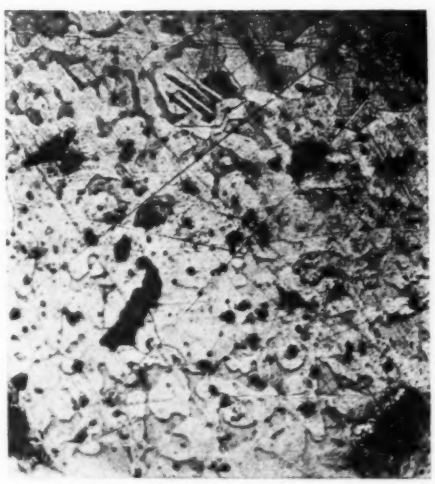

FIG. 3.—CHAIN LINK; AS FIG. 2, BUT HEAT-TREATED AT 950 DEG. C. FOR A FEW MINUTES AND COOLED FREELY IN AIR.

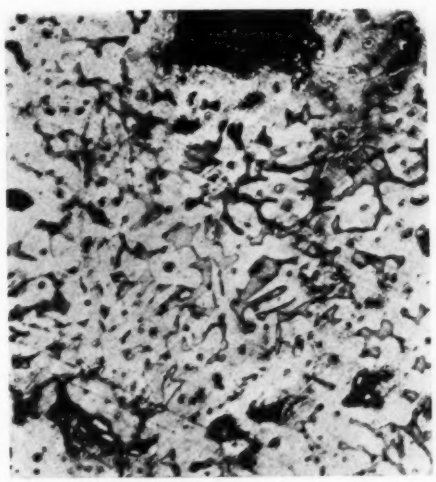

FIG. 4.—CHAIN LINK; HEAT-TREATED AT 950 DEG. C. FOR A FEW MINUTES AND COOLED FREELY IN AIR.

(All the photomicrographs are of transverse sections. ×150.)

* "Value of Science in the Smithy and Forge," pages 93 to 98.

The photomicrographs shown in Figs. 1 to 4, corresponding to pairs of links (1) to (4) respectively, show the crystalline structure of the material. Figs. 1 and 2 show a large grain size, whilst Figs. 3 and 4 show a smaller grain size. It will be seen, both from the photomicrographs and the breaking loads, that the high-temperature heat-treatment certainly did more good than annealing at 700 deg. C.

Experiments were continued on three pieces of wrought iron (Fig. 12) cut from the portion of the hook A, which was not fatigued, and on three pieces cut from the portion of the hook B, which was situated just below the fractured surface and which was in a fatigued condition. In each case the three pieces were treated separately as follow: (1) As received; (2) heated at 700 deg. C. for two hours and allowed to cool in the furnace, and (3) heated at 950 deg. C. for a few minutes and allowed to cool freely in air. The six pieces were then turned down to tensile test-pieces of 0.564 in. dia. with a gauge length of 2 in. and were broken, with the results shown in Table I:—

TABLE I.—*Tensile Results from Fractured Wrought-Iron Hook.*

Section	A.			B.		
Test-bar No. ..	1.	2.	3.	1.	2.	3.
Yield point, tons per sq. in.	17.86	14.29	17.05	14.21	15.36	17.75
Max. stress, tons per sq. in. ..	26.79	25.50	26.61	25.00	25.36	27.68
Ratio Y.P./M.S, per cent. ..	66.67	56.16	64.03	56.84	60.57	64.12
Elongation, per cent.	39.0	41.0	42.0	42.5	41.0	41.0
Reduction of area, per cent.	71.9	65.0	68.4	71.9	71.0	69.0

Figs. 6, 7 and 8 are photomicrographs of sections cut from the bars 1, 2 and 3 respectively, taken from portion A. It will be seen from Table I A and the photomicrographs that the treatment at 700 deg. C. not only materially reduced the ultimate strength of the material, but increased the size of the grains, whereas the higher-temperature heat-treatment had little or no effect on either property.

Figs. 9, 10 and 11 illustrate photomicrographs of similar sections cut from the fatigued portion of the hook, and correspond to B1, B2 and B3 respectively. Fig. 9 shows large grains, as would be expected from the coarsely-crystalline nature of the fatigue fracture; Fig. 10 shows grains of both large and medium size, whilst Fig. 11 shows nothing but small grains. Table I B shows a gradual increase in tensile strength from the untreated to the high-temperature heat-treated condition, but whereas the increase in ultimate strength of B2 over B1 is only 1.44 per cent., that of B3 over B1 is 10.72 per cent. Incidentally all the test-bars gave a fibrous fracture.

Conclusions.

These experimental results, coupled with the evidence of the photomicrographs, indicate that a temperature of 950 deg. C. should be used in preference to that of 700 deg. C. if maximum strength and minimum grain size be required. Cathcart† postulates the following conclusions: ". . . That the broken chain link in question had been subjected—as is the case more or less with all chains—to strain during service; that the subsequent annealing had been carried out at too low a temperature; that instead of doing good, much harm had been done; that the material had become brittle owing to the growth of large crystal grains; that in initially cold-strained material this growth takes place at an ordinary red heat, a temperature that is commonly thought to be correct; that the chain ought to have been annealed at 950 to 1,000 deg. C., and finally, if it had been inadvertently or ignorantly annealed at the low temperature,

† *Loc. cit.*

the fine structure could have been restored and the material thoroughly toughened by re-heating to a temperature of 950 deg. C."

On the other hand, the Home Office has recently issued a report‡ in which the authors find that "grain growth has not occurred as a result of repeated overstraining followed by annealing (at 650 deg. C. for 1 hr.), but normalising (at 1,000 deg. C. for 15 min.) following overstraining has had the effect of reducing the number of grains per sq. mm. to less than half the original figure." That is, the grain size is evidently larger following normalising than annealing. This is contrary to the results obtained in the present series of tests. The authors further state that "as a result of the present research it is concluded that chain failures in service are not due to the effects of heavy static overstraining, but rather to surface embrittlement caused by local impacts. With regard to static overstraining, it has been shown that neither subsequent low-temperature annealing nor normalising produces any deleterious effects on the properties of the chain, but actually effects an improvement, particularly in the case of normalising. With regard to embrittlement caused by local impacts, both heat-treatments are practically equally efficacious as restorative processes. Generally speaking, normalising is preferable. On the other hand, we have noticed many cases of chain links and chain iron bar which have split along the piling when normalised. Also greater wastage from scaling naturally occurs at the higher temperature. . . . It is apparent, therefore, that a normalising process applied to chains must necessarily be much more carefully conducted than a low-temperature annealing treatment. In view of these facts, it is suggested that the present practice of low-temperature annealing be retained."

It will be realised that the view expressed above, that low-temperature annealing is as efficacious as normalising, is contrary to that expressed by Cathcart that low-temperature annealing is definitely bad for overstrained material. Personal results point rather to Cathcart's view being correct, as, in these tests, the low-temperature annealing effected little or no improvement to the strained material. As the question of restoring strained material to a safe working condition is a vital one, affecting the safety of workmen, the author feels that some discussion on the matter would be helpful.

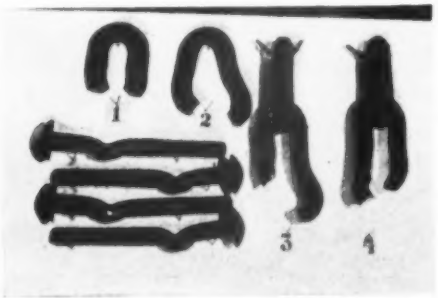

Fig. 5.—Showing Chain Links (1 to 4) and Bolts used in Breaking Links 3 and 4.

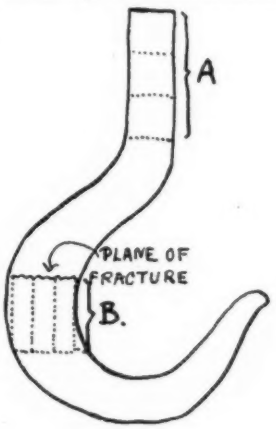

Fig. 12.

Fig. 6.—Portion of Hook, A1.

Fig. 7.—Portion of Hook, A2.

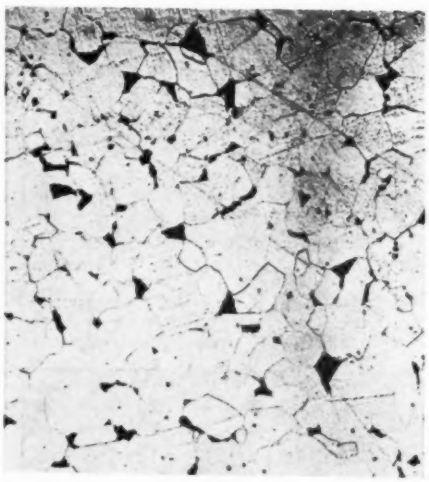

Fig. 8.—Portion of Hook, A3.

Fig. 9.—Portion of Hook, B1.

Fig. 10.—Portion of Hook, B2.

Fig. 11.—Portion of Hook, B3.

‡ "The Cause of Failure of Wrought-Iron Chains," by H. J. Gough, D.Sc., and A. J. Murphy, M.Sc.

Some Thoughts on Modern Foundry Developments.

MECHANISATION THE KEYSTONE.

At a meeting of the Birmingham, Coventry and West Midlands Section of the Institute of British Foundrymen, held on November 7, Mr. D. Wilkinson delivered his Presidential Address. The chair was taken by Mr. A. Harley, president-elect of the Institute. In the course of his address Mr. Wilkinson said:—

Mr. Harley and Gentlemen,—One of the most insistent of the demands of the day is for an improvement in quality. Against this demand nothing reasonable can be urged. All our natural instincts urge us to seek and obtain the best in all things; and wherever we can secure an article better suited to our requirements we are never satisfied until we have succeeded in acquiring it. If an article will give us better and more lasting service the desire to possess it is not only natural, it is reasonable, and common sense urges us to exert ourselves to obtain it. The same common sense that urges us to procure the best, also urges us to produce the best, and as reasonable beings we cannot be content if we are producing articles of inferior quality.

Coupled with this demand is another for a reduction in cost. Here, again, our natural instincts are in sympathy with the demand. Our sympathy may be secret, but it is real. We may demur to it; but our disinclination to pay more for an article than we consider it to be worth will prevent our objection from exercising its full weight. We fully realise the apparent inconsistency in coupling a demand for an improvement in quality with a reduction in cost; and we are quite conscious of the necessity of securing an adequate return for our exertions. But the knowledge that quality and cheapness are in themselves highly desirable will urge us to do our utmost to secure them.

It must not be forgotten that if vigour and vitality is to be retained in any business or industry, the gathering and co-ordinating of knowledge must proceed continuously, with the one object of applying the ordered knowledge to the betterment of product. This fact is widely recognised; and if its application were as equally wide as its recognition, it is possible that greater prosperity would be upon us.

Improvement in the quality of castings may perhaps be differentiated from improvement in the quality of the materials from which castings are made. No argument is needed to convince us that the finest grade of metal may, through unskilful handling, yield a very inferior casting. The production of sound castings, free from defects, both external and internal, often taxes the skill and ingenuity resulting from long years of experience. Too often an unsound job is the result of the failure of the designer to take full cognisance of the requirements necessary for the foundry to make a commercially-practical casting. Many designers who would not think of asking a rolling mill or a forge to produce a feature inconsistent with the method of manufacture, expect a foundry to cast a metal into any shape, and send to it patterns constructed without regard to the soundness of the finished product from the foundry viewpoint.

A Floating Core.

I recall an instance, in my own experience, which is almost incredible. A pattern was received for a steel casting weighing several hundredweights. On examination it was found that one of the internal cores was totally enclosed. No opening of any sort was provided. Even if it had been possible to have made the casting, it would not have been possible to have removed the core. This is doubtless an extreme instance; but only too frequently very little attention is paid to proper provision for the removal of cores and core irons, and other important factors. Again, engineers will not hesitate to machine off 30 per cent., or more, from a forging, but will refuse to allow a little extra machining on a casting even if it will completely remove a difficulty in obtaining perfect soundness. Such cases are of frequent occurrence, and constitute an ever present difficulty in the effort to make an article that is thoroughly sound and reliable. They will only be removed when the foundry world establishes so close a relationship with the engineering world, that its advice will be sought and followed when new designs are being developed.

Foundry Defects.

But when all these difficulties are removed many sources of unsoundness, entirely within the control of the founder, remain to be considered. Some of these we will mention briefly, although conditions do not permit the investigation they deserve.

(1) *Inferior Cupola Practice. This results in oxidised metal, or metal too cold to give uniformity to all parts of the casting.*—Usually when metal of this character is obtained the blame is laid to the coke or to the blast. But it will frequently be found that careful attention to the condition of the tuyeres, to the shape and repair of the lining and to the method of charging, will work wonders in improving the melt. With the amount of published information on cupola practice, there can be no excuse to-day for the inferior melting of metal. And it cannot be too strongly emphasised that the foundry that does not melt its iron hot and clean cannot possibly produce consistently sound castings, but will deliver articles that bring discredit upon itself and the foundry world generally.

(2) *Ineffective Sand Control.*—Until quite recently experience has been the only guide to the control of moulding sand. In efficient hands this method has given very satisfactory results. But the widely-differing qualities of sands and the variations existing in even the best and most uniform sand beds have hitherto been very definite obstacles to the consistent production of clean, smooth-surfaced castings. During recent years the investigation of moulding sands has been proceeding apace, and the knowledge obtained of their characteristics and properties is rapidly making it possible to establish rules to control them. It is too much to say that the methods of scientific control now available make experience in the selection and mixing of sands unnecessary. Quite recently I have been privileged to visit foundries where a very close, continual control is exercised over the sand, but the observed results were not always consistent. Experience is still able to produce results equal or superior to present methods of scientific control; but the regular tabulating of permeability, bond strength, size and percentage number of the grains, together with the moisture content, will be of great assistance to even the best and widest experience, and where trouble is making itself felt will enable effective steps to be taken to overcome it.

(3) *Want of Method in Gating.*—It is a truism to say that gating may make or mar a casting, but only too frequently this important part of foundry technique is left to the whim of the individual. We are all acquainted with moulders who have an almost unfailing instinct for the correct location of the gates on an important casting. But even the best man will fail sometimes, and I have always found it profitable to hold a consultation on the gating of special or new castings, and even more profitable carefully to study the gating of repetition castings. I know of no reliable rules to govern the shape, size, location or number of the gates needed successfully to pour a casting. In consequence, a short discussion as to the best method to adopt, taking in, if need be, several opinions, will always be found beneficial and will frequently save much trouble and prevent loss. Internal flaws and unsoundness result from inefficient gating and risering at least as often as from any other cause.

Alloyed Cast Iron.

Improvement in the quality of the metal used leads us in a rather different direction. Following the lead of the steelmaker who, by the addition of various metallic elements, has produced an exceedingly valuable series of alloy steels, various metals have been added to cast iron. Vanadium, titanium, chromium, nickel and molybdenum have all been used more or less extensively, and very definite improvement in quality has been established.

We are all familiar with the claims put forward by the suppliers of these alloying metals, and most of the claims are well substantiated. But the uniform dissemination of these metals through a volume of cast iron is by no means easy, despite all claims to the contrary.

An Experiment with Titaniferous Iron.

I recall a very definite instance of this occurrence. We were supplying a steady demand for small circular cast-iron cutters, with a thin chilled cutting edge. Teeth were ground in these chilled edges, and the cutters, mounted on a mandrel, were used for slitting sheet metal. Naturally, for work of this character, a good grade of iron was required. A request for a cutter with a longer life between grinding of the teeth led to a series of experiments to produce a harder chill. It was at last found that the addition of a small amount of titanium prolonged the usefulness of the cutter nearly three times. As the iron, to maintain the highest quality, was melted in a crucible, it might be considered that this was an ideal method of melting to secure a uniform admixture of the titanium. But despite every precaution, it was found that the life of the cutters was irregular, and analyses of the unsatisfactory cutters revealed an absence of titanium. It was ultimately found that the only way to obtain a uniform admixture of the titanium was to make a preliminary melt of the metals in the cupola. Before the ordinary melting for the day was started, a charge of the iron used for the cutters was put in the cupola; the titanium alloy, with an allowance for melting loss, was distributed in small pieces over the top of the charge, and the whole was melted and tapped out into a large ladle. It was then vigorously stirred and cast into pigs, which were broken up and remelted in the crucible. In this way a complete uniformity was secured, and irregularity in the life of the cutters was removed. This may serve as an example of the difficulty of securing a uniform admixture of an alloying metal.

Molybdenum in Cast Iron.

Recently, molybdenum has been extensively used, and is proving to be an excellent alloy for the improvement of the physical properties of cast iron. Figures recently published state that the addition of 2 per cent. of this metal to a foundry iron resulted in a transverse strength of 6,900 lbs. per sq. in., just over 3 tons, and a tensile strength of over 26 tons per sq. in. The Brinell hardness number was 302, but the iron machined easily. These are remarkable figures, and if the alloying metal were cheap much might be done with it. But as molybdenum costs somewhere about 5s. per lb., the increased cost is prohibitive; a steel casting would be cheaper.

But added in small quantities valuable results are claimed for it.

Electric-Furnace Iron.

When alloy cast irons are examined microscopically it is usually seen that there is a marked difference in the graphite content, both as to formation and distribution, and a definite grain-refining effect. Doubtless some of the alloying metal enters into solid solution with the ferrite, directly strengthening it. But usually the most obvious difference is in the grain size and the graphite shape and size. Now both these effects can readily be obtained in the electric furnace without alloys, yet with a similar improvement in the physical properties. Some years ago experimental melts of cast iron which I carried out in an electric furnace produced a metal with a remarkably fine grain and a small thin, well-distributed graphite, which gave tensile tests as high as 24 tons per sq. in. Quite recently I discussed this question with the metallurgists of two large corporations who use electric furnaces for special cast-iron work, and in each case the opinion was expressed that the electric furnace could produce a straight cast iron fully equal to the best alloy irons. In one case I was informed that molybdenum was used in the whole of their cupola metal, but that the electric furnace produced a metal which was at least as good as the best of the alloyed cupola metal.

With the continually-increasing use of electricity, it is not difficult to foresee a time when current will be cheap enough to enable the electric furnace to compete with the cupola. When this time arrives the greatly-improved qualities of electrically-melted cast iron will mean the speedy demise of the cupola and a much stronger and more reliable cast iron.

Heat-Treatment of Steel Castings.

When we turn to steel castings the field for improvement is very much wider. A fairly large number of alloy steels are well established and understood, and the use of their enhanced physical properties is limited only by their cost. But there is one definite method of considerably increasing the strength of an ordinary steel casting which, curiously enough, is seldom used. The properties of a manganese-steel casting can only be fully developed by a definite heat-treatment, and consequently every manufacturer of these articles is equipped with the necessary appliances for properly carrying out this treatment. The castings would be useless without it. Every engineering shop carefully hardens its steel tools by quenching from a predetermined temperature in various quenching media, and afterwards tempers the tool to the required toughness. Vast quantities of forgings, in which the crystal grains have been seriously deformed by drastic alteration of shape, have their structure restored and their strength and toughness developed by heating and quenching followed by tempering. Yet an ordinary steel casting seldom receives any heat-treatment beyond annealing, which consists in heating to a certain temperature and cooling slowly, or normalising, which consists of heating followed by cooling in air. And it is well known that an increase of approximately 25 per cent. can be obtained in the strength of a mild steel casting by heating it to about 900 deg. C., quenching and tempering at about 700 deg. C. But it is the exception to find a steel casting heated in this manner.

Boiling Water as Quenching Medium.

One reason for this is the well-known fact that drastic quenching is liable to cause cracks, which may be large enough to cause rejection, or may be so small as to escape detection, but sufficiently serious to cause failure in service. The irregular shape and sections of most steel castings make them very liable to this fault in quenching. But this difficulty is by no means insuperable. Experience has shown me that small castings which will develop cracks if quenched in cold water, can be quenched with perfect safety in boiling water, and will yield exactly the same improved tests. Metallurgists have found that by varying the composition and temperature of the quenching medium, tools may be quenched with safety, which would inevitably crack if quenched in cold water. Following up these facts, it should not be impossible to discover a medium which, at a temperature of, say, 400 or 500 deg. C., would quench a steel casting of any size and section without the risk of cracking. A retarded quenching of this character, which would finish at, say, 450 deg. C., allowing the residual cooling to take place in air, would without doubt give physical properties in no way inferior to those conferred by water quenching and tempering.

A very fruitful field for improvement in steel castings appears to be here presented to us. With a 25 per cent. increase in strength many castings could be so reduced in weight that their cost would be no greater, the profit on them would be no smaller, and their strength and utility would be in no way impaired and the demand for them increased.

Cost Reduction.

The road to reduction of costs is frequently a rough and thorny one. Some have found that even when the end of the road is reached the consequences incurred disturb the natural satisfaction that success should bring. Later we will introduce one of these disturbing consequences.

It may be asked why reduction of cost should be so continually emphasised. Why should purchasers always be demanding increased value for their money? As far back as my experience goes, and as much further back as I have been able to discover, the cry for reduced costs has been continuous, even to monotony, in the foundry sphere, and indeed in the whole business world. It has even been suggested that foundrymen themselves are not backward in asking for reduced prices when contracting for their supplies, thus urging the supplier to seek to reduce his own costs of manufacture. Probably the real reason is that most men can observe instances where waste, both of material and time, may be prevented; operations may be shortened; errors may be avoided, and by intelligent foresight delays may be stopped, not only in their own particular surroundings, but in others that they occasionally see. Certain it is that we must acknowledge, if we are honest with ourselves, that our own performance is seldom 100 per cent. efficient. It is the universal knowledge of this fact that in all probability leads to the demand for reduced costs, since no one wishes to receive less than full return of service for the money they pay.

One-Hundred-and-Seventy Tons of Handling.

It is not always easy substantially to reduce costs in any business. Speaking generally, a continual watch against waste of every description is one of the best ways to maintain the costs of an establishment at the lowest point. But there are several features in a foundry that are peculiar to itself. One is the large amount of labour required per unit of finished output. Some time ago I calculated the amount of labour required for the production of 1 ton of fairly small steel castings. Taking the different materials used and the number of times these were handled by separate individuals, I found the total weight handled amounted to over 170 tons per ton of castings made. This weight is put forward as an example, not as a standard. Obviously it will vary with the type of casting. But the very considerable amount of material handling in a foundry at once suggests the introduction of mechanical aid.

Utilising Floor Space.

Consider an ordinary, well-organised foundry the morning after an average cast. Everybody is busy clearing away the boxes, sand and castings, and in due time we find the moulders busy at their stations, their boxes in orderly stacks and their sand in well-mixed heaps. At the close of the day's work the floor will be well covered with moulds just poured. Realising that the prosperity of a foundry can be directly related to the output per square foot of space, let us consider another foundry of the same area, in which the floor is never occupied with sand heaps, or with boxes cast only once per day. The sand is always either in the box or out of the way in a sand conveyor and mixer system. The completed moulds, instead of being placed on the floor to await casting, are conveyed, as made, to a pouring station where they are cast, and then conveyed to a knock-out station, where the sand is returned to the sand system and the box returned to the moulder to be used again.

Mechanised Foundry Practice.

We can readily see that by using the boxes several times per day a large saving in capital outlay can be made. By keeping the floor free from sand and completed moulds waiting to be cast, a considerable area will be set free for the production of other castings; or, conversely, the same weight of castings could be made in a smaller shop. The immediate net result will be a large saving in capital expenditure and consequent on-cost. By being freed from much of the labour of handling his sand, and from many journeys about the floor with his moulds, the moulder will be able with the same expenditure of effort to produce more castings. By bringing the moulds to central pouring stations there will be a reduction of casting labour. Much less labour will be required to handle the sand and boxes, and the net result will be large savings in the cost of production. The moulding machines will be kept more continuously in operation, and so will impose a lower charge on the castings. The final result will be a very considerable increase in output and a large reduction in costs.

Mechanical Handling Advocated.

Do not imagine I am urging every foundry immediately to install conveyors. Far from it. Everyone must very carefully study the question from the point of view of their own production. It would be easy, fatally easy, to install machinery of such a nature that a return could not possibly be obtained from it. But after several years spent in studying this matter, I fearlessly make the assertion that there are very few foundries which could not make substantial reductions in their costs by a carefully-planned and designed system of mechanical handling of their sand, and possibly of their moulds. But there is no golden road to success in this matter. Every foundry is a separate problem and needs individual study and attention. It must never be forgotten that if an installation is not most carefully adapted to individual requirements the latter state of that foundry will be worse than the former.

Displaced Labour.

The inevitable result of a reduction of cost in this manner is a reduction in the number of men employed. It is not possible for any humane man to view undisturbed an increase in unemployment. Yet, on the other hand, if an article can be made by the expenditure of *one* hour's labour, it cannot be wise or economically sound to expend *two* hours upon it. Economy in labour is the only way to universal well-being. To employ labour uselessly, not to secure the utmost benefit from its expenditure, is to court disaster. The society that does not obtain from its labours the maximum amount of the commodities it requires can never be really prosperous. Hence there should be no hesitation to reduce labour wherever possible. But the advantageous use of the displaced labour requires, at least, careful consideration. As labour is potential wealth, the society that permits unemployment is heading for poverty. How then are we to deal with the labour that is displaced by the introduction of improved machinery?

Past Experiences.

The problem is not new, and its solution not yet in evidence. We have all read of the tremendous outcry that followed the introduction of cotton and wool weaving machinery, and how rioters, indignant because the machines were displacing them, fired the mills and destroyed the machines. When railways were introduced there was great commotion among the carriers of goods and passengers on the highways, and universal ruin was predicted. Equally when the Bessemer convertor first began to produce cheap steel the Jeremiahs of the country wept over the approaching ruin of the wrought-iron trade and the starvation of the men employed in it. Yet what would the world do to-day without its cotton and woollen industries, its railways and its steel production? Without these and other equally important industries the world would be infinitely poorer than it is.

DISCUSSION.

Latent Knowledge.

Mr. A. Harley (President-Elect), who took the chair, after saying that the address was commendably suggestive and would provoke thought, observed that there was a great deal of information regarding foundry methods published for their benefit, but he feared that only a small percentage of it was utilised by the majority. He recently had the opportunity of looking through some of the old records of the Institute —several of the Papers read at the Conventions for 1906-7-8—and he was astonished how up to date those Papers appeared to him in 1930. They were, of course, all very busy doing their daily work, and the opportunity for quietly studying the information at their disposal and putting it into practice was, perhaps, not easy to find; but he was sure that if they knew where to find information on matters with which they were not fully cognisant, and had the opportunity to apply it, they could effect great improvements. As to particular methods, the longer he lived and studied foundry practice, the more he was convinced that the crux of successful production lay in a thorough knowledge of the method of running, gating and risering a casting, and chilling it where necessary. The foundryman who could size up a design, and correctly place the gates and risers so as to ensure a sound casting reasonably often, was worth his weight in gold. There were intelligent men with, perhaps, little or no technical education who were very successful, because they had built up their ideas and methods from actual experience. This, however, was a slow or long way of becoming an efficient foundryman. There were scientific principles involved in the cooling down of a casting, Mr. Harley proceeded, which were somewhat difficult to understand. The question of liquid shrinkage, of solid shrinkage, of getting the molten metal to each part of the mould as soon as possible and at the same temperature, and of adopting means for equalising the cooling down—all this and more was involved in securing a sound casting. They might get what appeared to be a sound casting, even if it was not run in the best way, but unless the strains and stresses were eliminated by proper gating, a weak casting resulted. They tried to determine the approximate strength of a casting by test-bars and so on, continued Mr. Harley, in alluding to a weak design adversely affecting a casting. Incorrect running would render such a casting still weaker by causing internal stresses and strains, and it was sometimes very difficult to say just how strong a casting was. In certain classes of work this was so true that they had to allow 20 per cent. difference, sometimes rather more, as between the test-bar strength and the actual strength of the metal in the casting.

VOTE OF THANKS.

Mechanisation Doubles Output.

Mr. F. J. Cook (Past-President of the Institute), proposing a vote of thanks to Mr. Wilkinson for his excellent address, said he appreciated the references to the need for flexibility of mind. When they considered there were so many men in this country who, when taken off a job could never find another which would suit them, and yet if they went abroad would tackle any kind of work and do so successfully, the question of flexibility in industrial work struck one as of no little importance to the nation. As to the problem of the reduction of cost, he thought they were often too prone to consider wage reductions rather than improve methods which would enable a man to increase production more easily. For example, how many factories might adopt conveyors with advantage, which declined even to consider their possibilities? For the expenditure of a quite normal sum on such plant a South Wales foundry had doubled its output. Either another foundry had to be set up or better methods of production introduced; and improved production methods resulted in doubling the output on the same floor area.

Features in Quality Production.

He believed electric furnaces were bound to be progressively adopted for refining purposes. As to the addition of alloys to cast iron, he was suspicious of them and preferred to use an iron with the alloy "born in it." In this connection he cited the addition of varying proportions of silicon as causing the physical properties of the metal to become quite different. Sand control was a matter which was coming forward, and must do so increasingly. But brains had to be applied to the working of the plant. The finest plant (and the best methods) for measuring, mixing and ensuring the quality of sand which he had ever seen was on the Continent, yet he had never come across such scabby castings as were produced there. On the question of designs, he wondered how many foundrymen could properly discuss with a designer any particular design, and suggested they were apt to be wise after the event. It was a weakness of the foundryman that he was neither a designer, an engineer, nor a draughtsman, but by the National-Certificate course they hoped to produce men better equipped in this direction.

Mould Conductivity and Heat-Treatment

Mr. J. G. Pearce (Director of the British Cast Iron Research Association), in seconding the vote, said Mr. Wilkinson had thoroughly justified the custom of this particular form of address by placing before them matters which arose out of his long experience. The combination of scientific control and experience was required to obtain the best results, and brains were needed in exercising this scientific control. Commenting on heat-treatment, Mr. Pearce spoke of it as a form of governing the rate of cooling; and alluding to the two types of mould material, emphasised that sand was a bad conductor of heat, while cast iron was a very good conductor of heat. Between those two extremes they had to introduce various devices, but some day they might obtain a mould material by means of which they could automatically regulate the rate of cooling of whatever casting they might be making. After all, any form of heat-treatment was only an attempt to get over or to save the deficiencies of the mould material.

Mr. J. Linabury (an American whom Mr. Wilkinson met during his recent visit to that Continent) also spoke in favour of reducing arduous labour and increasing output by mechanical installations. Finally, Mr. Cook declared that too much stress could not be placed on gating.

Renitriding.—An article in a recent issue of "The Iron Age" points out that while denitriding and softening for machining can be readily accomplished, renitriding presents serious difficulties in that the denitrided but unmachined parts cannot have their surface hardness materially raised by renitriding. It is further pointed out that denitriding is dependent upon the temperature and time and not the media.

French Phosphoric Pig-Iron Syndicate.

As already announced, the French makers of pig-iron have decided to dissolve the phosphoric pig-iron branch of the O.S.P.M. (Office des Statistiques de Produits Métallurgiques) as from December 31, 1930. According to French statements, this decision is the result of competition from the producers in the Saar district, who are extremely active. In order more easily to combat the competition of the Saar works and at the same time prevent the break up of a combine which has proved to be of great advantage, the French makers had considered establishing a single selling comptoir, and negotiations towards this end had already taken place, but had to be abandoned. In the circumstances, it was necessary to act quickly, as it would have been imprudent to allow competition to develop without taking steps to meet it. It was recognised that the time required for the setting up of a comptoir for phosphoric pig-iron was too short, as the discussions concerning the quotas, etc., would have occupied too much time and it was, therefore, considered necessary to leave each maker to use his own discretion.

Despite the criticism which has been levelled at the O.S.P.M., it is thought that foundrymen will certainly regret the disappearance of this particular division of the organisation, which in its present form had regulated the French market since 1925 and which was in some respects a continuation of the old Longwy comptoir established about 50 years ago. The division in question had at least the great advantage of ensuring to the foundries a stability, both as regards prices and supplies. If at the present time the Saar works are able to offer prices which, are, perhaps, more acceptable than those of the French makers, this may be a political move as much as a commercial one. However that may be, the dissolution of the phosphoric pig-iron division means an upsetting of the equilibrium in the pig-iron market and a recrudescence of French and foreign competition in the French market, although the hematite section of the O.S.P.M. still continues.

Triple-Price Convention.

Although the Belgian foundry-iron syndicate, in which French makers are largely interested, will be unaffected by the collapse of the French division for phosphoric pig-iron, the triple-price convention of Belgian, Luxemburg and French makers is expected to lapse at the end of December. Reports from some quarters, however, state that this will not be the case, it being asserted that the triple convention will continue its activity without any change.

As a result of the decision to discontinue the phosphoric pig-iron division of the O.S.P.M. on December 31, a heavy fall in prices has already taken place. The division will continue to act until the end of the year, but will until then only attend to the distribution of orders among the producers, who will be subject to penalties for any excess output over their quotas. On the other hand, the control of prices was dropped as from November 1 and since then they have fallen by 100 fcs. the ton, so that No. 3 foundry iron is now at about 370 fcs., as compared with the official basis price of 490 fcs. It is considered doubtful whether the lower figure represents the bottom level, as makers are keenly competing with one another so as to be able to get as many orders as possible for next year. Under the circumstances, the prices of castings have again given way, and the foundries complain of considerable losses on their stocks of pig-iron and merchant castings. As a consequence, they are holding back in the placing of orders with the blast-furnace works, so that the latter will have to make further concessions.

Iron and Steel Output in October.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast declined by eight to 96 during October. Production of pig-iron in October amounted to 415,000 tons compared with 425,000 last September and 688,700 tons in October, 1929. The October output of steel ingots and castings was 512,500 tons, against 580,600 tons last September and 889,800 tons in October, 1929.

Mechanical Properties of Nickel Steel at Elevated Temperatures.

The strength properties of cast nickel steel at elevated temperatures were examined by E. Piwowarsky and H. Nipper.* The steel was melted in the basic open-hearth furnace. Part of the nickel was added in the furnace (1.5 per cent.) and a further addition was made in the ladle to get a content of 3 per cent. The compositions of the steels investigated are recorded in Table I. Of each kind two plates of 15.75 by 13.6 by 1.97 in. were cast vertically. The casting temperature was 1,545 deg. C. for the unalloyed steel and 1,520 deg. C. for the alloyed steels. One of the two plates was annealed, the annealing temperature being 870 deg. C. for the unalloyed steel, 820 deg. C. for the 1.54 per cent. nickel steel, and 780 deg. C. for the 3 per cent. nickel steel. The plates were slowly heated in the furnace, kept at temperature for 4 hours, cooled down to 600 deg. C. in the air, and then slowly in the furnace. The test pieces were cut from the lower halves of the plates.

There were examined the impact hardness, the tensile strength, and the notched bar impact strength. The hardness test was made with samples of 50 by 50 by 23 mm. They were heated in an electric muffle furnace, kept at temperature for half an hour, quickly put upon the anvil-block of the testing apparatus and tested. The ball of the hammer had a diameter of 10 mm.; the energy of impact was 300 mkg. The round samples for the tensile test had a diameter of 12 mm. and a gauge length of 60 mm. They were heated in an electric furnace while being held by the grips of the testing machine, kept at the required temperature for half an hour and broken. The increment of load was 0.4 kg./mm.²/sec. until the stretch limit was reached, then the increment was tripled. The notched bar strength was examined with samples of 160 by 20 by 15 mm., having a round notch of 4 mm. dia. in the centre and a testing area of 10 by 15 mm. The electric furnace in which the samples were heated was so arranged that the test pieces could quickly be pushed upon the anvil of the testing machine and broken. The tests were made with a Charpy machine of 25 mkg. capacity.

Table I.

Steel No.	C %	Si %	Mn %	P %	S %	Ni %	Cr %
A, B	0.33	0.36	0.88	0.043	0.030	—	—
C, D	0.35	0.31	0.88	0.017	0.025	1.54	0.23
E, F	0.35	0.31	0.82	0.017	0.026	3.00	0.20

In Fig. 1 the results of the hardness tests are illustrated, the plotted points being the average values of three tests. The curves show that the impact hardness of the steels investigated decreases with the increasing temperature until a minimum value is reached at about 400 deg. C. Then the hardness increases up to a temperature of 600 deg. C., then it rapidly decreases. The hardness increases with the increasing nickel content. At 400 deg. C. the unannealed samples show a greater hardness than the annealed ones; at 600 deg. C. the reverse is the case. At 800 deg. C. the three steels practically show the same hardness figures.

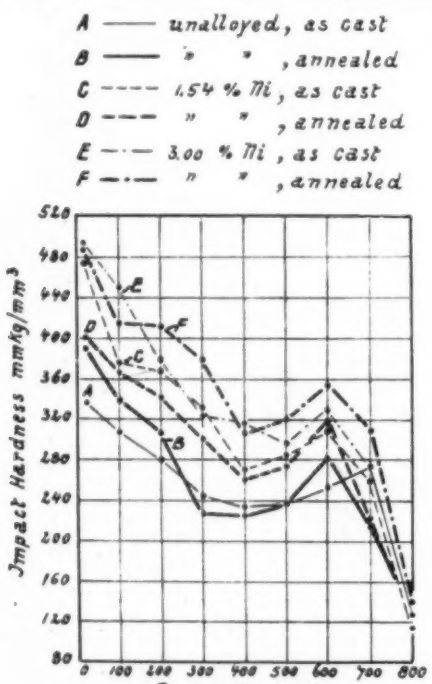
A —— unalloyed, as cast
B —— " " , annealed
C ---- 1.54 % Ni, as cast
D —·— " " , annealed
E —·· 3.00 % Ni, as cast
F —·— " " , annealed
Impact Hardness mmkg/mm²
Temperature °C.

Fig. 1.—Results of Hardness Tests.

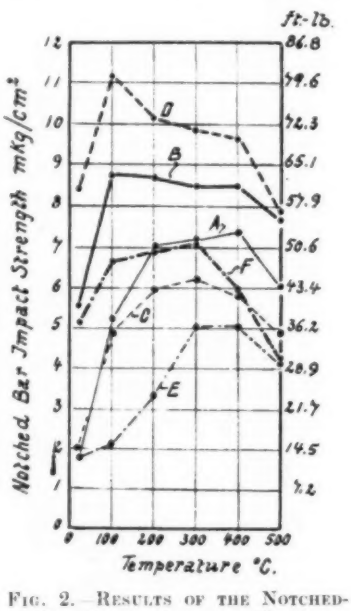

Fig. 2.—Results of the Notched-Bar Impact-Strength Tests.

The results of the notched bar impact strength are shown in Fig. 2. The curves rise with the increasing temperature, and have a maximum value at between 100 and 400 deg. C., then they fall off. In the as-cast condition the impact strength decreases with the increasing nickel content. When annealed the samples with 1.5 per cent. of nickel show the best values, whereas those with 3 per cent. of nickel come last.

The curves representing the tensile strength (Fig. 3) generally fall off from room temperature to 200 deg. C. (100 deg. C. with the unalloyed steel in the as-cast condition), then they rise and have a maximum value of 300 deg. C., and finally rapidly fall off. The steel with 3 per cent. of nickel shows a different behaviour; its strength increases from a very low value at room temperature to a maximum value at 300 deg. C. and then rapidly decreases. The tensile strength of the annealed samples is higher than that of the unannealed samples, and increases with the increasing nickel content. The stretch limit gradually decreases with the increasing temperature, and is influenced by annealing and by the nickel content in the same manner as the tensile strength. Elongation and contraction of area show maxima at between 100 and 200 deg. C. and minima at 300 deg. C. In the unannealed state they decrease with the increasing nickel content. In the annealed state the samples with 1.5 per cent. of nickel show the highest values and those with 3 per cent. of nickel the lowest values.

As the authors state, the samples containing nickel were annealed at too low a temperature, especially those with 3 per cent. of nickel. Properly annealed, they might show better values than in the present investigation.

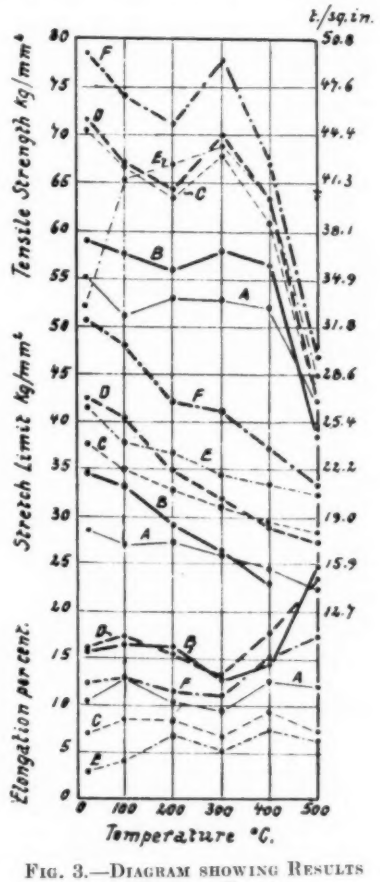

Fig. 3.—Diagram showing Results of Further Tests.

Applications for Trade Marks.

The following list of applications to register trade marks is extracted from the "Trade Marks Journal":—

"Durehete."—Machinery and metal goods. Samuel Fox & Company, Limited, Stocksbridge, near Sheffield.

"Gecalloy."—Metallic alloys. The General Electric Company, Limited, Magnet House, Kingsway, London, W.C.2.

"Ajax."—Pig-iron. Yorkshire Iron & Coal Company, Limited, Tingley, near Leeds.

A reorganisation scheme to be carried out by the English Electric Company, Limited, involves the gradual closing down of the engineering side of the Dick, Kerr works at Preston. The car-building works are not affected. The company intend gradually to transfer the work of the engineering side now carried on at Preston to other branches at Stafford, Rugby and Bradford. All the work now in hand will be proceeded with, but no new work will be brought in.

* "Die Giesserei," No. 14, 1930.

Cupola Practice in the Malleable Iron Foundry.

By J. H. D. Bradshaw (Metallurgist, Messrs. Bradley & Foster, Limited).

For a long time it has been recognised, in this country at any rate, that the most reliable malleable iron castings have been the product of crucible or "pot" melted metal. Castings so produced are supposed to be much superior to those produced from cupola-melted iron. This superiority is attributed to different causes, the principal being:—(1) Small carbon and sulphur pick-up, with little silicon and manganese losses; (2) the whole of the charge, being in one container, is uniformly mixed, thereby ensuring castings of uniform composition, and (3) furnace atmosphere.

There are several disadvantages to crucible melting, however, that must be apparent to every foundryman, namely, (*a*) the small output, (*b*) the great expense, and where a large output is required, the greater floor space needed for the furnaces, etc.

On the grounds of effecting necessary economies in the production of malleable iron, the cupola is gradually displacing crucible melting, as it is undoubtedly the cheapest medium for melting iron. Its principal disadvantage is, however, that the composition of its product cannot always be guaranteed. After considerable experiment it has been found that careful control of the cupola practice will yield castings equal to, and in many cases much superior to, crucible melted ones; this being accompanied by a considerable reduction in cost of production.

In the production of good-quality malleable cast iron, one of the principal factors to be constantly borne in mind is that regularity of composition of metal is of vital importance. Should this be liable to sudden change or variation, trouble is sure to be experienced during the subsequent annealing operation. For example, suppose there are two batches of castings (similar section), one containing, say, 0.6 per cent. silicon and the other 0.35 per cent. of this element (other constituents being equal). It must be clear to everyone that if the annealing conditions are conducted to suit the higher silicon castings, then the lower silicon batch will be insufficiently annealed, that is they will be hard and brittle. On the other hand, should the conditions be made to suit the lower silicon castings, then the higher silicon ones will be over-annealed, and probably of the type known as "rotten."

From a metallurgical standpoint, there are really only two important points to consider in the production of good malleable cast iron. These are (1) the production of suitable metal, and (2) the correct annealing of castings made from this metal, each of these factors being in turn dependent upon many other factors.

In the malleable iron foundry a fairly small cupola is generally employed, one of 14 to 22 in. dia. at the melting zone being favoured, lined with a single row of bricks, and having four or six tuyeres arranged in a single row. The section of tuyere area to area of melting zone should be in the ratio of 1:10. For regularity of working, the following factors need careful consideration, and in order to ensure the production of uniform metal, should, as far as possible, be standardised:—(1) The correct volume of air corresponding to the production of the cupola must be supplied; (2) the pressure of the blast must be sufficient to reach the centre of the cupola; (3) the charge (pig-iron, scrap, etc.) must be correctly calculated and constant; (4) the amount of coke used for the bed must be determined by experiment.

Volume of Air Required.

The quantity of air required depends upon the quantity of coke used, and is therefore dependent on the melting capacity of the cupola. The melting capacity of the cupola is determined by its effective diameter at the melting zone. In practice, it is found that a cupola working efficiently will normally melt 10 lbs. of iron per hour for every inch of horizontal area at the tuyeres. In a malleable iron foundry having a cupola of 15 in. dia., the melting capacity will therefore be 1,767 lbs. per hr.

In practice, excellent results are obtained by allowing 160 to 170 cub. ft. of air for each lb. of coke.

As the efficiency of the coke is only 40 per cent. of the theoretical quantity, the actual amount required for an hourly production of 1,767 lbs. will be $\frac{268.7 \times 1,767}{2,240} = 212$ lbs. of coke per hr., exclusive of bed coke. This will require 36,040 cub. ft. of air per hr. for successful operation.

Blast Pressure.

This should be sufficient to penetrate the centre of the cupola and charge, and the correct pressure is best determined by experiment on each individual cupola. Volume and pressure gauges should be fitted to the blast main as near the tuyeres as possible, so that the blast, and incidentally the actions of the furnaceman, may be controlled.

Calculation of the Charge.

In order to obtain an iron of constant composition it is necessary to take into consideration the two following factors:—(1) The losses and gains in the furnace, and (2) the exact chemical composition of all the materials forming part of the charge. The losses in the cupola are, of course, part of the silicon and manganese; the gains being sulphur and (sometimes) carbon.

In ordinary grey-iron foundry practice the losses are usually calculated on a 10 to 12 per cent. basis; the sulphur being, as a rule, the only item to gain. In the malleable foundry, however, it is indeed very good practice when the oxidation of silicon does not exceed 35 per cent., or the manganese 45 per cent.

With regard to increase ("pick-up") the carbon is the principal factor. When the charges introduced are low in carbon, this element is absorbed prior to melting until a constant carbon content of 2.8 to 3.0 per cent. is reached. On the other hand, should the charge contain over 3 per cent. of this constituent, it is not so liable to this modification.

A decrease in blast pressure also incurs the liability of an increase in carbon.

Calculation of Silicon and Manganese.

Here again there are two factors to be considered, namely (1) the silicon and manganese contents required in the castings, and (2) the losses that take place during melting (say, Si 35 per cent. and Mn 45 per cent.).

The weight of gates and runners produced per ton of castings varies in different foundries, and also depends to a large extent upon the size and type of casting being produced. It may vary from 40 to 60 per cent., and it is a great temptation to founders to use as much as possible of this return scrap on the charge. The scrap content used in cupola-melted malleable mixtures is of the greatest importance in deciding the qualities of the finished product. When too much is used the tendency is for the silicon to fall more or less gradually until eventually it is too low for effective annealing within the usual time and temperature limits. At the same time the sulphur content increases, thereby giving additional annealing and shrinkage troubles. In practice it is found that a mixture of one-third foundry scrap is usually the limit to which one can go with safety. Some foundries, however, use as much as 50 per cent., or even more of this low silicon scrap, which is sure to result in the production of low silicon castings.

The silicon desired in the castings varies with the thickness of section, and the following may be taken as typical of usual practice:—Castings, $\frac{1}{8}$-in. to $\frac{3}{16}$-in. thick—silicon, 0.65 to 0.75 per cent.; castings, $\frac{3}{16}$-in. to $\frac{1}{4}$-in. thick—silicon, 0.55 to 0.65 per cent.; castings, $\frac{1}{4}$-in. to $\frac{5}{8}$-in. thick—silicon, 0.50 to 0.55 per cent.

Lower silicon iron than 0.5 per cent. is difficult to obtain in a perfectly fluid condition. It also leads to porosity and abnormal shrinkage at sharp internal corners of the castings.

Manganese should not be below 0.35 per cent. for good results. Unfortunately, however, it is (generally speaking) much below this figure. Most malleable ironfounders believe that this element stabilises the carbide, thereby lengthening the period of anneal. This is only true of the manganese in the form of the double carbide (Fe Mn)$_3$C, and in normal practice there is insufficient manganese present to produce this compound. The tendency of manganese is to combine with the sulphur; therefore, both have a neutralising effect upon each other. By so doing the manganese really assists annealing, and the writer has produced excellent castings containing 0.5 to 0.6 per cent. of this element, the castings in question having a sulphur content of 0.3 to 0.4 per cent. The total carbon in the hard casting should not exceed 3.3 per cent.

Sulphur.

It is not generally recognised that sulphur may exist in the coke in at least three different forms, as follow:—(1) As alkali sulphate (*e.g.*, calcium sulphate); (2) metallic sulphide (*e.g.*, sulphide of iron), and (3) organic composition (hydrocarbonic sulphide). When the coke is burnt in the cupola, the alkali sulphate is absorbed by the slag. The metallic sulphide passes into the iron, while the third escapes with the gases, and may be recognised by its characteristic odour.

From a study of the above, it is clearly seen that it is the condition in which the sulphur exists in the coke, rather than the total amount present that is of primary importance to the malleable ironfounder, and possibly explains the well-known fact that when using some high sulphur cokes the "pick-up" by the iron is not so great as when using other cokes with a lower amount.

Chemical analysis will give the total sulphur present in the coke, which for safety should not exceed 0.7 per cent. Sulphur in the castings should be as low as possible, and it is only by a judicious selection of coke and materials, and paying attention to the working of the cupola, that this can be obtained.

Phosphorus.

During melting, the phosphorus does not change, that is there is neither loss nor gain, except by concentration, so an iron or mixture of irons containing the desired phosphorus content must be used. For really good-quality whiteheart malleable this should not exceed 0.1 per cent. Beyond this limit there is a tendency to produce brittleness in the annealed castings. The castings also have a low shock value (*i.e.*, cold short), usually accompanied with a low elongation figure.

Steel Scrap.

This is frequently used now by some foundries in the production of so-called "steel-mix" malleable cast irons. The scrap used should for preference be of the heavy type, consisting of axle and billet ends; selected types of stamping scrap are also suitable, and horseshoes, tyres, rails, etc. Light steel scrap of the type obtained from cold-pressed work should not be used owing to its great bulk and excessive loss by oxidation. Further, it has the great disadvantage of causing irregularities in the working of the cupola, and scaffolding has frequently occurred even after

pressing the material into blocks with a hydraulic press.

When steel forms part of the charge a slight alteration in the method of charging is advisable. The steel, having the highest fusing point (1,450 deg. C.), should be charged first, followed by the new pig-iron, and finally the foundry scrap, which will have a melting point of approximately 1,230 deg. C.

Bed Coke.

The coke for the bed should be measured, not weighed, and the height of the bed so adjusted that iron arrives at the tapping spout 15 min. after the blast is put on. If the iron does not appear in this time it is evident too much coke has been used, which is not only wasteful, but has a large influence on the carbon and sulphur increases (especially in the first charges). It also has a great effect on the oxidation losses.

The correct volume of coke required is best determined experimentally for each cupola, taking the necessary precautions, however, to maintain a constant blast volume and pressure during the tests, which may occupy a week or more. As in grey-iron practice, the time required for burning the bed varies from 1½ to 2 hrs. before commencing to blow.

Temperature of Metal.

In the malleable foundry a casting temperature of 1,400 to 1,450 deg. C. is required, depending, of course, on the type and size of castings being produced. It is usually judged by the colour and "liveliness" of the surface of the metal in the ladle, although some system of pyrometric control is to be preferred.

The temperature of the iron is generally classified as (*a*) cold, (*b*) passable, (*c*) hot, and (*d*) very hot iron. A cold iron is useless and is usually "dumped" on to the scrap for remelting. A passable iron may be used for large castings, but is absolutely useless for thin sections, whilst a hot iron is suitable for thin and small sections. A very hot iron gives an excessive shrinkage, with the liability of causing "draws" and searing; it should not be poured until after allowing to cool down, except for extremely thin castings.

Indications of Composition.

To an experienced moulder or caster, there are several indications of the composition and temperature of the iron. Sometimes test-bars are cast, and the suitability of the iron determined from the resultant fracture. However, with experience, one can judge by the colour and vitality of the molten iron its suitability for the work in hand.

A practical cupola-man can readily distinguish between molten grey and white irons as they flow from the furnace. These differences are entirely spectacular and based upon the extremes of the two classes. If the iron passing the cupola spout is hot, but appears lifeless and dull, one may conclude it is high in silicon. That is, it is normally a grey iron. It lacks vitality and does not produce "scintillations."

On the other hand, an iron low in silicon, that is a white iron, has a lively colour, the surface has very rapid movement, and the flow is accompanied by the production of numerous fascinating scintillations.

Slag.

A careful examination of the slag is of vital importance, for upon the quantity of slag produced the losses may be determined. In malleable this loss is considerably greater than in ordinary grey-iron foundry practice, and the difference between the two slags is clearly shown in Table I.

The slag is formed principally by oxidation of silicon, manganese and iron, adhering sand on the pig-iron together with silica and alumina from the lining of the cupola. When the results given above are calculated to elements, Table II is obtained. From a study of this latter table the greater loss in malleable practice is clearly seen. It will be noticed the loss is 40 per cent. more in malleable than in grey-iron work.

Table I.—*Composition of Grey- and Malleable-Iron Slags.*

Constituent.	Grey iron.	Malleable.
	Per cent.	Per cent.
SiO_2	42.20	52.60
Al_2O_3	7.51	12.50
Fe_2O_3	5.17	10.02
MnO	2.10	3.60
CaO	37.00	2.15
MgO	0.22	0.33
S	0.5	0.7

The colour of the slag is usually a blackish-green, flowing with great difficulty. The wear on the cupola is also much greater than in grey-iron practice, this being proved by the greater quantity of alumina passing into the slags, *i.e.*, 12.5 per cent. for malleable against 7.51 per cent. when producing grey iron (see Table I).

Table II.—*Metallic Concentration in Grey- and Malleable-Iron Slags.*

	Grey iron.	Malleable.
	Per cent.	Per cent.
Si	19.83	24.72
Mn	1.63	2.80
Fe	3.72	7.84
	25.18	35.36

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

16,814. Halbe, G. Method of dissolving and removing metallic fouling from the surface of iron and steel objects. 333,963.

17,964. Pollak, J. E. (Thompson, R. D., and Mills, G. C.). Electrodes or welding rods for use in the process of electrically welding or depositing metals. 333,985.

20,267. Wellman Smith Owen Engineering Corporation, Limited, and Plumley, E. W. Furnaces for the heat treatment of metallic or other bodies. 334,006.

27,418. Vereinigte Stahlwerke Akt.-Ges. Producing iron carbonyl. 319,356.

4,639. Hydraulik Ges. and Schlenstedt, O. Method of and apparatus for the manufacture of metal tubes by extrusion presses. 334,159.

16,438. Wennerstrom, K. G. Melting metal or heating molten metal in an electrical furnace, and a furnace for carrying out the said process. 334,201.

16,785. Standard Telephones & Cables, Limited. Lead alloy for electric cable sheath and other purposes. 314,522.

17,245. Boulton & Paul, Limited, North, J. D., and Johnston, V. J. Metal spars for aircraft. 334,287.

18,513. Krupp Grusonwerk Akt.-Ges., F. Presses for extruding metals. 316,259.

20,190. Dunsheath, P. Extrusion of metal pipes and the like. 334,315.

22,150. Krupp Grusonwerk Akt.-Ges., F. Manufacture of cast-iron grinding balls. 319,350.

24,860. Szidon, V. Preparation of hypochlorites of alkali metals. 334,364.

30,513. Beardsley, E. O., and Piper, W. F. Foundry moulding machines. 334,416.

32,263. Hall, H. C., and Bradbury, T. F. Aluminium alloy. 334,430.

13,011. Grönwall, E. A. A., and Nathorst, H. J. H. Production of metals from ores. 334,500.

Surface Hardening.

The "Shorter" Process.

At a meeting of the Institution of Welding Engineers, held in London on Thursday, November 13, Mr. A. E. Shorter read a Paper on "Metal Surface Hardening," in which he described the patented "Shorter" process.

The "Shorter" process machine, said the author, consists of an operating head designed to carry an oxy-acetylene blowpipe and quenching apparatus in proper relation to the work. This head is provided with controls which enable the operator accurately to adjust the burner to the work piece. These controls are arranged with sensitive movements in various directions to facilitate adjustment if necessary, during the actual operation, although the setting up for the operation may be so correct that further alteration is unnecessary during application.

The operating head is mounted so that the burner can be applied to the work placed within a specially-designed water tank. The tank is provided with vertically adjustable turntable bearings with suitable means for regulating the height of the water which is constantly flowing during the operation.

The oxy-acetylene burner does not, as has been supposed, alter the composition of the steel by imparting carbon, thereby producing a hard surface. It has been suggested that results are obtained by using a blowpipe with an excess of acetylene, thereby introducing carbon into the surface of the metal. This, however, is not the case. The blowpipe is used solely for the purpose of imparting heat to the surface of the metal.

New Steelworks in Pretoria.

Contracts for British Firms.

Three British firms have successfully tendered for the main plant of the new works which the South African Iron & Steel Industrial Corporation, Limited, backed by the Union Government, intends to build in Pretoria. The official announcement states that the most acceptable tenders for the plant in the main departments were :—(1) For the steel-melting shop and rolling-mill departments, Messrs. Dorman, Long-Demag; (2) for the blast-furnace plant, Messrs. Ashmore, Benson, Pease & Company, Limited; (3) for the coking and by-product plant, the Woodall-Duckham Company. Messrs. Dorman, Long & Company, Limited, it is stated, jointly tendered with Messrs. Demag, A.-G., of Duisburg.

The coke-oven contract will be carried out by the Woodall-Duckham Vertical Retort & Oven Construction Company (1920), Limited, and will comprise a large installation of Becker coke ovens, complete with by-product recovery plant. The coking plant will produce coke for use in blast furnaces, the ovens being fired by blast-furnace gas. The coke-oven gas will be utilised in various parts of the works. The contract which has been entrusted to the Woodall-Duckham Company includes coal-handling, storage, crushing and mixing plant; Becker regenerative and combination-type coke ovens; coke-screening plant; and complete by-products plant for the recovery of ammonia, motor fuel and tar products.

The blast-furnace plant to be installed by Messrs. Ashmore, Benson, Pease & Company, Limited, will be of Freyn design.

B.S. Classification of Symmetrical Light Distributions from Lighting Fittings.—The need has long been felt for a common terminology by which the characteristics of lighting fittings can be briefly described and compared, and the British Engineering Standards Association has now issued a specification which it is felt will be of great assistance in the illumination field. This is the British Standard Classification of Symmetrical Light Distributions from Lighting Fittings, No. 398-1930. Copies can be obtained from the British Engineering Standards Association, Publications Dept., 28, Victoria Street, London, S.W.1. Price 2s. 2d. post free.

The Aluminium Development Competition.

As briefly announced in our issue of October 2, the Bureau Internationale de l'Aluminium are organising an international competition carrying £800 in prizes with the object of expanding the use of aluminium. As we should like this to result in a confirmation of the precept that the British are inherently inventive, we reproduce in full the conditions which have been established for its adjudication.

Rules for the International Competition for the Development of the Uses of Aluminium and its Alloys.

1.—A competition open to inventors of any nationality will be held by the International Aluminium Bureau with the object of encouraging the development of the aluminium industry. Prizes will be offered for the best suggestions for new applications of the metal and its alloys or for improvements in its manipulation. Subject to the provisions of Clause 15 the competition will be held annually.

2.—The competition will be divided into two sections:—

Section A.—Direct Applications: This section will deal with all proposals relating to the manufacture of an article or machine or part of a machine in aluminium or aluminium alloy.

Section B.—Indirect Applications: This section will deal with all proposals relating to improvements in the methods of working or using aluminium or its alloys (*e.g.*, soldering, insulating, plating, etc.).

All proposals will be allocated to the appropriate section by an adjudicating committee whose decision will be final.

3.—Proposals are to be submitted in type-written form, in duplicate, in either English, French or German (*vide* Clause 8).

4.—The proposals submitted must be sufficiently complete to allow the value of the suggestion to be fully understood for adjudication. They should contain a detailed description (or model if so desired) of the article, with drawings, dimensions, weight, etc., or of the process, and should give sufficient data to admit of experimental trials to enable the claims to be verified.

5.—The adjudicating committee will be composed of five persons; one nominated by the Director of the Bureau and four engineers nominated by the four aluminium companies associated with the Bureau and hereinafter referred to as the "associated companies."

6.—The decision of the committee respecting the award of the prizes will be final.

7.—The prizes offered, which will be awarded in the month of June, are as follow:—

(*a*) A prize of 25,000 French francs for the best entry under Section A (*vide* Clause 2).

(*b*) A prize of 25,000 French francs for the best entry under Section B (*vide* Clause 2).

In the event of two or more entries in either of these two sections being judged equal in merit, the committee may divide the prize money.

(*c*) In addition to the above two prizes, a special prize of 50,000 French francs will be awarded to the author of a suggestion which has exceptional interest or value under either section.

Should the committee consider that none of the entries is worthy of the special prize in (*c*) it will not be awarded.

8.—The opening date of the competition will be January 1, 1931. Entries must be sent in between that date and April 1, after which date no entry can be accepted for that year's competition. The entries submitted will be examined by the committee without delay and the results will be announced at the latest by July 1.

All entries must be in type-written form and must be signed by their author, whose address should also be given. Copies in duplicate must be forwarded by registered post to the "Bureau Internationale de l'Aluminium," 23-bis, Rue de Balzac, Paris, 8e. No responsibility will be accepted for documents lost in transit.

One of the duplicate copies will be retained by the Bureau. The second will be sent to a member of the committee, if possible of the same nationality as the author, who will examine the proposals and report to the committee.

If a competitor does not belong to one of the nationalities represented on the Committee, the report will be made by a person to be chosen by the Bureau.

In order to facilitate the task of the Committee, should the number of entries be very great, the Bureau reserves the right of eliminating those which are obviously not of sufficient merit.

9.—Until the last date for submitting entries (*i.e.*, April 1) competitors have the right to withdraw or alter their entries. After this date and before the announcement of the awards, the authors have the right to withdraw but not alter their entries.

10.—Except as provided by Clause 11, no invention for which a patent has been granted *before* the opening date of the competition is eligible for an award.

11.—In order to protect their ideas, competitors may apply for Letters Patent covering their invention, provided that their application occurs after the opening date of the competition. The Bureau on its part undertakes not to divulge publicly the contents of the manuscripts submitted for the competition, which have not received an award, so long as they remain in their possession.

Should the competition be held for several consecutive years (*vide* Clause 15), a competitor who has not been able to complete his work in time for the competition one year shall have the right to take out a patent before the opening date of the competition of the following year, on the express condition that, either previously or at the same time, he shall submit his specification to the Bureau, who will keep it until the opening of the next competition.

12.—The act of submitting a proposal to the Bureau for the purpose of this competition is to be regarded as constituting an offer of the invention for sale, in the first instance to the Bureau and then to any of the associated companies, on terms and conditions to be mutually agreed.

This option to purchase is granted in the first instance to the associated companies as a body, and, failing exercise by them, the option passes to the associated companies individually, in an order of priority to be mutually agreed between them.

In the event of the Bureau or its associated companies refusing the offer, or their inability to agree on a price for the acquisition of the invention, the author can resume his rights, whether or not a patent has been taken out.

The Bureau or the associated companies can intimate their intention of exercising the right thus reserved to them within three months from the announcement of awards or of the taking out of a patent. If no such intimation is made before October 1, the author resumes all rights to his invention.

13.—Entries which do not receive an award will be returned to their authors, but they may be re-entered for any subsequent competition which the Bureau may decide to hold.

14.—In submitting a proposal to the Bureau for the purpose of this competition, the inventor agrees to accept all the rules and regulations as herein set forth.

15.—The competition, according to the present rules and regulations, will be held annually if the Bureau so decides, but notice of each competition will be advertised before December 1 of each year.

16.—Persons belonging to any of the associated companies can only take part in the competition with the permission of their company.

17.—These rules have been drawn up in French, English and German. In the event of any difficulties in interpretation, the French text shall be accepted.

Publication Received.

Molybdenum in Steel and Iron. Published by Messrs. High Speed Alloys, Limited, Ditton Road, Widnes.

We seldom remember receiving a more interesting publication than the one under review. Interest is immediately established by the reproduction of two graphs, the first of which shows that the consumption of molybdenum steel and iron has grown from 25,000 tons in 1918 to 625,000 tons in 1929, whilst the second shows, by means of a stress-strain diagram, the curves of carbon steel, nickel steel and nickel-chromium molybdenum steel. The progress is thrown into high relief by dating the carbon steel 1880 to 1900, the nickel steel 1900 to 1918 and Ni-Cr-Mo steel 1918 to 1930, but should 1930 have been included. Why not a query?

The compiler has, after his introductory remarks, made two very good points: the elimination of temper brittleness and the reduction of the effect of mass. This latter property was, possibly, just brought to the notice of iron-founders by the claims of the Perlit process. This same sense of clear presentation characterises the sections on the physical properties of molybdenum steel, the mechanical processes and heat treatment.

Obviously, quarternary alloys (excluding C, Si, Mn, S, P and Fe) are very difficult to rationalise, but it seems clear from practical experience that the problem of the utilisation of the series Cr-Al-Ni-Mo has been resolved in connection with nitrogen hardening.

Machining speeds of high-tensile steels are shown to be capable of improvement by molybdenum additions, whilst strength improvements permit of weight reductions. Again, Ni-Cr-Mo steels are shown by Fig. 3 to maintain their cold strength until virtually 300 deg. C. The last section, dealing with fabricated steels, refers to copper steels, which Americans value as being resistant to corrosion, and the beneficial effect of small molybdenum additions. The compiler is very general in his statements as to the effect of molybdenum on steel castings, but is much more definite when dealing with cast iron. Here he states very definitely that "the effect, 1.5 per cent. molybdenum on a plain iron having a tensile strength of 11 tons per sq. in., is to increase this to 19 tons per sq. in." A 12-cwt. increase is claimed for the transverse strength. Here, of course, size of bar should be stated. The 1.5 percentage is apparently critical, as above that figure, say at 3.0 per cent., intense hardness supervenes.

Claims for the utilisation of molybdenum for both grain and chill rolls are interestingly and convincingly detailed. The final section deals with the economic factor. On the debit side for molybdenum cast iron one must put at the current price of 9s. 9d. per ton for 0.10 per cent., and on the credit side soundness, machinability, extra life and all the other technical claims. We congratulate the compiler of this brochure on the excellence of his plan of attack and presentation of his subject.

CLINTZ LIMESTONE QUARRY, Egremont, owned by United Steel Companies, Limited, resumed work recently with a full complement of men, after being idle for three weeks.

Trade Talk.

The staff of Messrs. R. & A. Main, Limited, Gothic Iron Works, Falkirk, held their annual card party and dance on November 15 in the Mathieson Rooms, Falkirk.

The "Guayra," a new passenger ferry boat built by Messrs. A. & J. Inglis, of Pointhouse, Glasgow, for South American owners, has successfully completed a 500-miles' trial on the Firth of Clyde.

The motor-driven oil tanker "Norfold," built by Messrs. Barclay Curle & Company, Limited, to the order of Messrs. Johan Rasmussen & Company, Norway, has completed satisfactory trials on the Clyde.

It is announced that the Linthorpe-Dinsdale Smelting Company, Limited, Middlesbrough, have decided to blow in one of the four blast furnaces at their Middleton works. One furnace will be put upon the production of ferro-manganese.

Messrs. Christmas & Walters, Limited, 8, Grosvenor Gardens, London, S.W.1, have received a further order from the Patent Shaft & Axletree Company, Limited, Wednesbury, for an R. D. Wood gas machine and plant, this being the fourth order they have received from the firm for their gas machines.

Messrs. Monard, Limited, of Savoy House, 115, Strand, London, W.C.2, has been formed to manufacture and market a range of the well-known Monard case-hardening compounds. These preparations are non-poisonous, light in bulk, free from dust and porous. They carburise when in contact with steel heated to 880 deg. C. at the rate of 2 mm. per hour.

Messrs. Ferguson Bros. (Port Glasgow), Limited, have launched, complete with all machinery on board and ready for work, the suction-cutter dredger "Prince Farouk," which has been built to the order of the Tilbury Construction & Dredging Company (Egypt), Limited, for service in the Sudan. The ladder has been fitted to enable the vessel to cut in front and make her own flotation.

Messrs. Stewarts & Lloyds, Limited, closed their Clydesdale steelworks at Mossend on November 15 for an indefinite period, owing to slack trade. It is intended that the stoppage shall be only temporary, and it is hoped that a restart may be made in a week or two, but orders have gradually dwindled until those on hand do not justify a full week's working. About 1,500 men will be thrown idle.

At an extraordinary general meeting of the holders of the debenture stock of the British Aluminium Company, Limited, resolutions consenting to the modification of the trust deed so as to authorise the company at any time to redeem the whole of the debenture stock outstanding at 110 per cent. were unanimously adopted. It was stated that the amount of debenture stock outstanding was £491,909.

The annual dinner of the Institution of Engineering Inspection was held at the Connaught Rooms, London, W.C.2, on November 5, Mr. Hal Gutteridge (President) in the chair. Those present included Sir Arthur Balfour, Bt., Sir William J. Larke (director, National Federation of Iron and Steel Manufacturers), Mr. Herbert J. Davey, M.B.E. (past-President and Member of Council), the Rt. Hon. Sir Richard A. Squires (Prime Minister of Newfoundland), Lt.-Col. J. H. M. Greenly (Vice-President), and Lt.-Col. J. T. C. Moore-Brabazon.

Amongst visits of interest to be made by members of the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen during November is one to the 5,000-ton hopper dredger "Rietbok," which is the largest suction hopper dredger yet built on the Clyde. The vessel has been constructed by Messrs. Wm. Simons & Company, Limited, of Renfrew, for the South African Railways and Harbours Administration. Another visit will be to the Clyde Foundry of Messrs. Harland & Wolff, Limited, at Govan, which is one of the largest iron foundries in the country.

Shipbuilding employers and representatives of the workers met recently to discuss the effect of rationalisation on employment in the yards. The men's representatives claimed compensation for workmen displaced by reorganisation in the industry. No decision was arrived at, and the conference adjourned. The meeting comprised a small committee of the shipyard trade unions, the Shipbuilding Employers' Federation, and representatives of National Shipbuilders' Security, Limited, a company formed a few months ago to eliminate redundant shipyards and concentrate work in the larger and more efficient yards.

Messrs. Yarrow & Company, Limited, of Scotstoun, have received an order from the London County Council for 10 Yarrow boilers for the Tramways Department electric power station at Greenwich. The value of the order is over £200,000, and represents one of the biggest contracts for water-tube boilers that has been placed in this country in recent years. The Yarrow water-tube boiler, which is well established and known throughout the world for marine work, is gaining increased prominence for land work. Messrs. Yarrow have also received orders through the Crown Agents for the Colonies for a twin-screw shallow-draft steamer, to be built on the Yarrow system, and two lighters. These vessels are for service in Equatorial Africa.

Executives of all the unions concerned with men in the engineering industry met in London to consider the position arising out of the protracted negotiations for an all-round increase in wages of 8s. a week. In March last the engineering employers finally refused to grant the application of the unions for a wage advance. The unions asked for a Government inquiry, but the Minister of Labour rejected the proposal and suggested that the employers' organisation and the unions should themselves investigate the problems of the industry. The conference decided that it was unable to accept the suggestion of the Minister of Labour, and decided to refer the whole matter of future policy in regard to the wage claim back to the executives of the various unions for consideration.

Mr. Tom Shaw, Minister for War, and Admiral of the Fleet Sir Roger Keyes, who were among the guests of the Master Cutler (Mr. Peter Boswell Brown), at the Cutlers' Feast at Sheffield, made a tour recently of the works of Messrs. Hadfields, Limited, of which firm the Master Cutler is Deputy Chairman. They and other members of the party were afterwards entertained to lunch by the directors. Sir Robert Hadfield, chairman of the company, who presided, made an appeal to those present to support British manufacturers in every possible way. This, he said, could be done without introducing fiscal questions. A great deal could be done by mutual help and co-operation. British steels were second to none in quality, and in these days it paid to use none but the best.

To obtain closer co-operation, the associated companies of Messrs. John Thompson, Limited, are transferring their drawing and estimating offices, etc., from London to their works, so that in future all tendering and projects will be dealt with from Wolverhampton and Dudley. All the companies in the John Thompson group, namely, John Thompson Water Tube Boilers, Limited, John Thompson (Wolverhampton), Limited, John Thompson (Motor Pressings), Limited, John Thompson (Dudley), Limited, John Thompson Beacon Windows, Limited, and the Kennicott Water Softener Company, Limited, will continue to have offices in Imperial House, Kingsway, London, W.C.2, and a London director or manager and staff will be attached to each company, but at Wolverhampton and Dudley will be situated the head offices for the whole of the companies in the group.

Wills.

Gardner, John, general manager of the Redheugh Iron & Steel Company, Limited £15,893

Sim, G. G., deputy chairman of Messrs. Vickers, Limited, and of Vickers-Armstrongs, Limited £38,957

Crookes, B. H., for 15 years departmental manager in the Scotswood Works of Sir W. G. Armstrong, Whitworth & Company (Engineers), Limited, of Newcastle-upon-Tyne ... £4,071

Obituary.

Mr. Benjamin J. G. Street, a director of Messrs. B. J. G. Street & Company, Limited, iron, steel and metal merchants, Liverpool, died recently, aged 67.

Company Meeting.

Stewarts & Lloyds, Limited.—An extraordinary general meeting of Messrs. Stewarts & Lloyds, Limited, was held in Glasgow on November 5. Mr. A. C. Macdiarmid (chairman), who presided, said that the object of the meeting was to consider proposals (outlined in our issue of October 23) for increasing the capital of the company by the creation of a class of shares to be known as liaison deferred shares, in order that the company might ally itself with the important group of companies controlled by Tube Investments, Limited. The chairman said that the agreement into which they proposed to enter was in no sense an amalgamation, but a pursuance of the policy of avoiding wasteful competition, particularly as to organisation and technical research, which he referred to in his remarks at the last annual general meeting. He was convinced that in effect the international relations into which they had already entered had been of considerable benefit to the company; without them the situation in the present period of world-wide depression would have been almost impossible owing to the fierce competition that would have prevailed for the exiguous tonnage available. The resolutions were carried.

Contracts Open.

Bedworth, November 25.—Two centrifugal pumps, etc., for the Bedworth Urban District Council. Mr. H. W. Crowther-Green, Council Offices, Bedworth. (Fee £2 2s., returnable.)

Buxton, November 29.—Castings, for the Town Council. Mr. F. Langley, borough engineer, Town Hall, Buxton.

Dewsbury, November 29.—Two reciprocating sludge pumps, for the Corporation. The Borough Engineer, Town Hall, Dewsbury. (Fee £2 2s., returnable.)

Haddington, December 2.—40 tons of cast-iron segment plates, for the East Lothian (Western District) Water Board. Messrs. G. H. Hill & Sons (Manchester), 40, Kennedy Street, Manchester. (Fee £2 2s., returnable.)

London, E.C., November 28.—Cast-iron manhole covers, cantilever brackets and fire bars, for Associated Builders' Merchants, Limited, Peters Hill, Upper Thames Street, London, E.C.4. (Fee £1 1s., returnable.)

Rhyl, December 2.—Five miles of cast-iron pipe sewers, for the Urban District Council. Mr. R. Green, 37, Bennetts Hill, Birmingham. (Fee £3 3s., returnable.)

Spalding, November 22.—1,600 yds. 3-in. cast-iron water mains, for the Spalding Rural District Council. (Fee £2 2s., returnable.)

Vancouver.—Pig-iron, for a local firm. The Department of Overseas Trade. (Reference A.X. 10,472.)

Reports and Dividends.

Siemens Brothers & Company, Limited.—Interim dividend of 2½ per cent.

Allen-Liversidge, Limited.—Dividend on the preference shares for the six months ended October 31, 1930.

John I. Thornycroft & Company, Limited.—Net profit, £95,876; brought in, £61,882; dividend on the ordinary shares of 13 per cent.; to reserve, £20,000; benevolent fund, £5,000; carried forward, £59,258.

Guest, Keen & Nettlefolds, Limited.—Interim dividends on the first and second preference shares. Decision as to a dividend on the ordinary shares is postponed until the accounts for the full financial year are made up.

New Companies.

Cranfield & Pease, Limited, 2, Duke Street, Luton.—Capital £4,000. Ironfounders and engineers. Directors: F. G. Pease, W. Pease, W. H. Cranfield and S. J. Cranfield.

Bruntons (Musselburgh), Limited, Station Road, Musselburgh.—Capital £100,000, in £1 shares (95,000 "A" and 5,000 "B"). Wire and wire rope manufacturers, etc. Directors: J. D. Brunton, J. Sinclair and Mrs. H. E. Brunton.

SKLENAR MIDGET FURNACE

OIL – FIRED
(Gas-fired if desired).

CHARACTERISTIC FEATURES:

No crucibles or pit fires required.
Compact with rapidity of service.
Perfect control of atmospheric conditions in the furnace with temperatures ranging from 500°C. to 1600°C.
Low fuel consumption.
Better metal and reduced metallic losses.
Metal under observation throughout.
Reduced cost of upkeep.
Cost of production reduced 60%.
Perfect control of alloys.
Oil burning equipment capable of running for long periods without fear of breakdown.

OUTPUT
2 COMPLETE CHARGES OF 320 LBS COPPER ALLOYS MELTED IN ONE HOUR AFTER PREHEAT

OIL CONSUMPTION: 4½ gallons per hour of fuel oil.

OTHER STANDARD SIZES FOR NON-FERROUS METALS: Coke or Oil fired up to 2 tons. Larger sizes on application.

OIL FIRED FURNACES FOR MELTING GREY IRON AND SEMI-STEEL: Sizes and prices on application.

WILL SAVE UP TO £900 PER ANNUM.

SEND US YOUR ENQUIRIES_____OUR TECHNICAL STAFF IS AT YOUR SERVICE.

COPYRIGHT DESIGN INDUSTRIAL REVENUES LTD. ETHOS

BRITISH REVERBERATORY FURNACES LTD.
88, KINGSWAY · LONDON, W.C.2.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The position in the Cleveland iron trade is practically without change, although, it may be observed with an undercurrent rather more hopeful that business will shortly mend for the better. So far, however, there is little evidence in existing conditions to support the theory of an early revival of a strong home demand. An additional blast furnace is to be put into commission, but it is to produce ferro-manganese, and its re-starting does not indicate any increase in the demand for ordinary pig-iron. This is, however, a move in the right direction and may mark the first turn in the trade tide, which has been on the ebb for so long. The demand for ordinary grades of Cleveland foundry and forge iron is still very limited, and it must be confessed that there is little indication of any improvement. On the other hand, however, foreign competition has become more intense, and while export sales of local iron are more difficult to negotiate, more British consumers have been tempted to use foreign iron on account of the low prices at which it has been offered. In the meantime, buyers are by no means confident that prices can be maintained, and, moreover, as they are slack at present, they are disinclined to commit themselves to the purchase of raw material until it is actually needed. The fixed minimum rates in Cleveland are maintained, No. 1 foundry iron being quoted at 66s. per ton, No. 3 Cleveland G.M.B. at 63s. 6d., No. 4 foundry 62s. 6d., and No. 4 forge iron at 62s. per ton.

Producers of East Coast hematite are situated rather more favourably than makers of foundry iron, home and export demands showing gradual improvement, and stocks being reduced within reasonable limits. Slightly increased export sales are reported, but these are mostly at rather less than the recognised home price, which for mixed numbers is 71s. and for No. 1 quality 71s. 6d. per ton. On the North-West Coast, Bessemer mixed numbers are quoted firmly at 70s. per ton, at works.

LANCASHIRE.—Interest in local foundry trade circles has of late been centred upon anticipations of an early cut in pig-iron rates, and this welcome movement has now materialised in a recent decision of the Midland furnace proprietors to reduce their prices by 2s. 6d. per ton. This concession, however, can hardly be described as completely satisfactory to consumers, and has, so far, had no outstanding effect upon business in the local markets, which remains quiet and uneventful, few buyers caring to enter into further commitments in existing conditions. Current quotations now rule:—No. 3 Derbyshire, 69s. 6d ; with No. 3 Staffordshire at the same figure, delivered free at local stations. Scotch brands are in limited demand, and are now quoted down to 91s. per ton, also delivered local stations.

THE MIDLANDS.—For some time past consumers of foundry pig in the Black Country have been looking to the furnaces to reduce prices, and recently their hopes were realised, the makers announcing a reduction of 2s. 6d. per ton. Current prices for Midland iron, therefore, are now 67s. 6d. for Northants No. 3 and 71s. for North Staffordshire and Derbyshire No. 3, delivered local stations. There have been further transactions in foreign pig-iron at 66s. 6d. delivered, but, in view of the fact that selling arrangements for this iron on the Continent have broken down, it is quite possible that still lower offers will come through.

SCOTLAND.—The Scottish pig-iron makers continue to complain of lack of business. Some think that, in view of the fall that has taken place in other irons, the prices should be reduced, but others maintain that any reduction would not increase the volume of business, and the price therefore remains unchanged on the basis of 76s. 6d. for No. 3 foundry, f.o.t. furnaces.

Finished Iron.

In the existing conditions of trade generally, it is at least satisfactory to learn that in one or two directions it is reported that the demand for crown bars is moving upwards a little, but this progression is only partial, as some of the works can only find sufficient business to enable them to work periodically. Prices are unchanged at from £10 to £10 5s. for Staffs crown bars, although crown iron from other directions is being offered at round about £9 15s. Staffordshire marked bars, for which the demand keeps up to a fairly steady level, are unchanged at £12 10s. at works. There is little or no call from local makers for nut and bolt iron, as the bulk of requirements for this trade are obtained from French and Belgian sources. Continental No. 3 nut and bolt iron is quoted at £5 5s. to £5 7s. 6d. delivered works in the Darlaston area, whereas £8 15s. to £9 would be the Staffordshire figure.

Steel.

Reports from Sheffield indicate that the only thing that can be said of the steel market is that business is no worse. Buying is everywhere on a very limited scale, everybody being apparently very uncertain about the immediate future. Acid-billet requirements are small, hard basic billets are quiet, and the bulk of soft basic billet orders are going to Continental producers, whose prices are well under British quotations. Competition in wire rods is also severe. Prices are unchanged. The demand for finished steel has been rather more active of late, and this has imparted a somewhat brighter tone to the market, but in this department, as in other sections of the iron and steel trade, the pressure of foreign competition is keen, as the prices of all Continental steel materials have fallen to a very low level. The tinplate market continues quiet, with quotations ruling at 17s. basis for best coke quality, net cash, f.o.b. South Wales ports.

Scrap.

The business passing in this class of material at the moment is unimportant in volume, and prices mostly disclose a lower tendency. On Tees-side the foundries are quiet, prices inclining to a lower scale. Ordinary heavy cast iron is now worth no more than 50s. per ton, and good machinery quality, though offered in handy sizes at 53s. 6d. per ton, is not in demand. In Yorkshire there is a little business in heavy cast-iron scrap at the lower figure of 51s. for ordinary quality, machinery grade remaining at 53s. 6d. delivered. In Scotland, first-class machinery cast in handy foundry pieces is quoted at 60s., with ordinary cast iron to the same specification at 52s. 6d. to 55s., and steelworks metal 50s. Light cast iron is at 43s. 6d. to 45s., with furnace firebars 42s. 6d. Old cast-iron railway chairs are unchanged at 57s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—The steady advance in prices of standard copper continued throughout last week, and may not yet be exhausted, although some retrogression has been seen this week. Similar conditions prevail in America, culminating in the sale of 18 million pounds at the week-end, a day's total not exceeded for many years. The October statistics disclosed an increase of 4,000 tons in stocks of refined copper, while reserves of blister copper were up by 3,000 tons.

Closing quotations :—

Cash.—Thursday, £49 5s. to £49 7s. 6d.; Friday, £50 15s. to £50 17s. 6d.; Monday, £49 12s. 6d. to £49 13s. 9d.; Tuesday, £47 12s. 6d. to £47 15s.; Wednesday, £46 to £46 2s. 6d.

Three Months.—Thursday, £49 7s. 6d. to £49 10s.; Friday, £50 15s. to £50 17s. 6d.; Monday, £49 12s. 6d. to £49 13s. 9d.; Tuesday, £47 12s. 6d. to £47 15s.; Wednesday, £46 to £46 2s. 6d.

Tin.—The market for standard tin, in contrast with that for copper, although closing slightly better, has remained quiet and uneventful. Production appears to be on the increase again, and buying is none too good either on this side or in the United States, while stocks are, of course, still very ample. The future is very uncertain, and it would not be surprising to see the price fall, at any rate to the previous low level of £107.

Official closing prices :—

Cash.—Thursday, £115 to £115 5s.; Friday, £116 15s. to £116 17s. 6d.; Monday, £115 to £115 2s. 6d.; Tuesday, £113 5s. to £113 7s. 6d.; Wednesday, £113 5s. to £113 7s. 6d.

Three Months.—Thursday, £116 10s. to £116 15s.; Friday, £118 2s. 6d. to £118 5s.; Monday, £116 7s. 6d. to £116 10s.; Tuesday, £114 10s. to £114 12s. 6d.; Wednesday, £114 7s. 6d. to £114 10s.

Spelter.—This market drifted down to £14 10s., from which point there was some recovery, but the outlook is not very bright, and stocks in America at the end of October showed a marked increase. Business in high-grade spelter for next year is on a fairly good scale.

Daily fluctuations :—

Ordinary.—Thursday, £14 18s. 9d.; Friday, £14 18s. 9d.; Monday, £15 6s. 3d.; Tuesday, £14 16s. 3d.; Wednesday, £14 11s. 3d.

Lead.—The market has been rather featureless, but adequate control by the producers has kept the price pegged at £15 10s. on the London market. Consumers are not showing much interest at present, but much change is unlikely just now.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £16; Friday, £16 13s. 9d.; Monday, £16 16s. 3d.; Tuesday, £15 17s. 6d.; Wednesday, £16 2s. 6d.

British Chemical Standard "Bronze" (Brass) "B."—The fifth of the series of non-ferrous standard-analysed samples is now ready for issue. The analysis shows the following percentages:—Copper, 58.8; zinc, 33.9; manganese, 1.03; iron, 0.94; aluminium, 1.62; tin, 1.76; lead, 0.78; nickel, 1.01; arsenic, 0.03; antimony, 0.05; total, 99.92. The composition is reasonably typical of that of some of the best grades of manganese-bronze at present manufactured, and includes all the elements likely to be found in such an alloy. The standard is available to anyone at a price based on ultimately covering the cost of preparing and issuing it. The three usual sizes, 50-, 100- and 500-grm. bottles are provided together with a certificate of analysis with each bottle. Further particulars may be obtained from Headquarters, 3, Wilson Street, Middlesbrough.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 52 & 53. MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

"ATLAS"
SELF-TEMPERING CHISEL STEEL
FOR THE FOUNDRY

" . . . to be ground, yes! but how often?"

The whole of the efficiency of any chisel steel rests upon the answer to this question. No matter what the cost of the chisel steel may be—it is the cost of more or less frequent re-grindings which really counts. The edge of a fettling chisel made from "Atlas" Self-Tempering Chisel Steel has a rare quality of "staying put." Long spells of air-tool work have but a minimum effect upon

"The edge which it's hard to dull."

JOHN BROWN & CO., LTD.
ATLAS WORKS, SHEFFIELD

WHITTAKER'S Improved MOULDING MACHINE

By which Wheels or Pulleys of any description or size from 3 inches to upwards of 20 feet diameter can be made.

THE MOST COMPLETE & EFFICIENT MACHINE HITHERTO INTRODUCED TO ENGINEERS.

All Machines warranted to Mould with the greatest accuracy and precision.

GEARING WHEELS

Spur or Bevel, Straight Teeth and Double Helical Teeth Supplied to Consumers.

ROPE AND BELT PULLEYS

WM. WHITTAKER & SONS, LTD.
SUN IRON WORKS - - - - OLDHAM.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	46	0	0
Three months	46	0	0
Electrolytic	50	0	0
Tough	48	10	0
Best selected	49	0	0
Sheets	84	0	0
India	61	10	0
Wire bars	56	15	0
Do. November	56	15	0
Do. February	56	15	0
Ingot bars	56	15	0
H.C. wire rods	56	0	0
Off. av. cash, October	43	1	5 13/20
Do., 3 mths. October	43	0	8 37/40
Do., Sttlmnt., October	43	1	1 3/8
Do., Electro, October	46	6	6 5/8
Do., B.S., October	45	14	8 3/8
Do., wire bars, October	46	17	7 7/8
Solid drawn tubes			12d.
Brazed tubes			12d.
Wire			8d.

BRASS.

Solid drawn tubes	10½d.
Brazed tubes	11½d.
Rods, drawn	10d.
Rods, extd. or rlld.	6d.
Sheets to 10 w.g.	9d.
Wire	9d.
Rolled metal	8½d.
Yellow metal rods	6d.
Do. 4 × 4 Squares	6½d.
Do. 4 × 3 Sheets	6½d.

TIN.

	£	s.	d.
Standard cash	113	5	0
Three months	114	7	6
English	114	5	0
Bars	116	5	0
Straits	117	15	0
Australian	116	5	0
Eastern	118	15	0
Banca	118	5	0
Off. av. cash, October	117	11	1 1/20
Do., 3 mths., October	119	0	5 3/20
Do., Sttlmt., October	117	11	1 1/20

SPELTER.

	£	s.	d.
Ordinary	14	11	3
Remelted	12	10	0
Hard	11	5	0
Electro 99.9	17	0	0
English	15	2	6
India	12	5	0
Zinc dust	20	0	0
Zinc ashes	3	10	0
Off. aver., October	14	13	9 15/20
Aver., spot, October	14	8	10 35/40

LEAD.

	£	s.	d.
Soft foreign ppt.	16	2	6
English	17	10	0
Off. average, October	15	14	2 5/8
Average spot, October	15	14	11 3/8

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	0	0
Do. V.M. ex-whf.	25	0	0
Rods	28	0	0
Boiler plates	21	0	0
Battery plates	21	0	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	36	0	0
Chinese	25	0	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 17 6
45/50%	£11 10 0
75%	£18 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£15 17 6
Ferro-tungsten—	
80/85%	2/3 lb.
Tungsten metal powder—	
98/99%	2/6 lb.
Ferro-chrome—	
2/4% car.	£30 10 0
4/6% car.	£23 2 0
6/8% car.	£22 5 0
8/10% car.	£22 0 0
Ferro-chrome—	
Max. 2% car.	£32 17 6
Max. 1% car.	£37 15 0
Max. 0.70% car.	£40 0 0
70%, carbon-free	11d. lb.
Nickel—99% cubes, or pellets	£175 0 0
Ferro-cobalt	9/7 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0 to £11 15 0
76/80% packed	£12 0 0 to £12 15 0
76/80% export	£10 10 0 to £11 0 0
Metallic manganese—	
94/96% carbonless	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 2
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	2	5	0	to	2	7	6
Bundled steel and shrngs.	2	0	0	to	2	4	0
Mixed iron and steel	2	0	0	to	2	2	6
Heavy cast iron	2	10	0	to	2	12	6
Good machinery for foundries	2	12	6	to	2	15	0
Cleveland—							
Heavy steel			2	6	0		
Steel turnings			1	15	0		
Cast-iron borings			1	10	0		
Heavy forge			3	2	6		
W.I. piling scrap			2	17	6		
Cast-iron scrap	2	10	0	to	2	13	6
Midlands—							
Ord. cast-iron scrap			2	5	0		
Heavy wrought			2	15	0		
Steel turnings	1	0	0	to	1	2	6
Scotland—							
Heavy steel			2	10	0		
Ordinary cast iron			2	14	6		
Engineers' turnings			1	15	0		
Cast-iron borings			1	15	0		
Wrought-iron piling			3	5	0		
Heavy machinery			3	0	0		

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	41	0	0
Brass	31	0	0
Lead (less usual draft)	14	10	0
Tea lead	11	0	0
Zinc	8	0	0
New aluminium cuttings	50	0	0
Braziery copper	38	0	0
Gunmetal	40	0	0
Hollow pewter	80	0	0
Shaped black pewter	60	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	66/-
Foundry No. 3	63/6
Foundry No. 4	62/6
Forge No. 4	62/-
Hematite No. 1	71/6
Hematite M/Nos.	71/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/6
„ d/d Birm.	88/6
Midlands—	
Staffs. common*	—
„ No. 4 forge*	66/-
„ No. 3 fdry.*	71/-
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	62/6
„ fdry. No. 3*	67/6
Derbyshire forge*	66/-
„ fdry. No. 3*	71/-
„ basic*	—
*d/d Black Country dist.	
Scotland—	
Foundry No. 1	79/-
„ No. 3	76/6
Hem. M/Nos.	77/-
Sheffield (d/d district)—	
Derby forge	61/-
„ fdry. No. 3	66/-
Lincs. forge	—
„ fdry. No. 3	67/6
E.C. hematite	83/6
W.C. hematite	86/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
„ fdry. No. 3	69/6
Staffs foundry No. 3	69/6
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	91/-
Glengarnock, No. 3	—
Eglinton, No. 3	91/-
Gartsherrie, No. 3	91/-
Monkland, No. 3	91/-
Shotts, No. 3	91/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)	10	0	0	to	10	15	0
Nut and bolt iron	8	15	0	to	9	0	0
Hoops	10	15	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip	10	15	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	7	6	to	10	5	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¼ in. (Untested)					7	12	6
					and upwards		
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy					8	10	0
Fishplates					12	0	0
Hoops (Staffs)	9	5	0	to	9	10	0
Black sheets, 24g.	8	15	0	to	9	15	0
Galv.cor.shts., 24g.					11	12	6
Galv fencing wire, 8g. plain					12	0	0
Billets, soft	5	12	6	to	6	5	0
Billets, hard	7	10	0	& up.			
Sheet bars	5	12	6	to	5	15	0
Tin bars					5	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/1
Sheet to 10 w.g.	1/1½
Wire	1/2
Rods	1/1½
Tubes	1/6
Castings	1/1

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
3/0 to 10 G.	1/5½ to 2/0½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	18.76
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	14.00
Basic	18.76
Bessemer	19.26
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	31.00
Sheet bars	31.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.70
Steel hoops	1.95
Sheets, black, No. 24	2.45
Sheets, galv., No. 24	2.95
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.95
Plain wire	2.30
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	25/- to 26/-
„ furnace	16/- to 19/-
Durham and Northumberland—	
„ foundry	14/6 to 15/-
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	17/-
„	28×20 „	34/-
„	20×10 „	24/6
„	18¾×14 „	17/9
C.W.	20×14 „	15/6
„	28×20 „	32/-
„	20×10 „	23/6
„	18¾×14 „	17/-
Terneplates	28×20	31/- per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.
Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water	58½%	42½%
Steam	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Nov.	13	49	5	0	inc.	85/-
,,	14	50	15	0	,,	30/-
,,	17	49	12	6	dec.	22/6
,,	18	47	12	6	,,	40/-
,,	19	46	0	0	,,	32/6

Electrolytic Copper.

		£	s.	d.		
Nov.	13	51	0	0	inc.	70/-
,,	14	53	10	0	,,	50/-
,,	17	52	10	0	dec.	20/-
,,	18	50	0	0	,,	50/-
,,	19	50	0	0	No change	

Standard Tin (cash).

		£	s.	d.		
Nov.	13	115	0	0	inc.	92/6
,,	14	116	15	0	,,	35/-
,,	17	115	0	0	dec.	35/-
,,	18	113	5	0	,,	35/-
,,	19	113	5	0	No change	

Tin (English ingots).

		£	s.	d.		
Nov.	13	116	0	0	inc.	90/-
,,	14	117	15	0	,,	35/-
,,	17	116	0	0	dec.	35/-
,,	18	114	5	0	,,	35/-
,,	19	114	5	0	No change	

Zinc Sheets (English).

		£	s.	d.		
Nov.	13	24	0	0	No change	
,,	14	24	0	0	,,	,,
,,	17	24	0	0	,,	,,
,,	18	24	0	0	,,	,,
,,	19	24	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Nov.	13	14	18	9	inc.	5/-
,,	14	14	18	9	No change	
,,	17	15	6	3	inc.	7/6
,,	18	14	16	3	dec.	10/-
,,	19	14	11	3	,,	5/-

Lead (English).

		£	s.	d.		
Nov.	13	17	10	0	inc.	10/-
,,	14	18	5	0	,,	15/-
,,	17	18	5	0	No change	
,,	18	17	5	0	dec.	20/-
,,	19	17	10	0	inc.	5/-

Imports and Exports of Iron Castings in October and the ten months 1930, compared with October and the ten months 1929.

	October, 1929.	October, 1930.	10 months, 1929.	10 months, 1930.	October, 1929.	October, 1930.	10 months, 1929.	10 months, 1930.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	1,667	2,259	28,131	17,645	17,167	23,798	315,299	208,930
Castings, in the Rough, Iron	198	293	2,563	2,050	4,160	6,188	58,335	43,873
,, ,, ,, Steel	1,277	735	11,657	11,321	30,461	19,130	262,210	270,799
Hollow-ware, Cast, not Enamelled	7	9	31	35	700	776	2,746	3,543
,, ,, Enamelled	9	12	91	30	400	647	4,548	1,758
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	117	109	1,631	1,632	5,344	5,027	75,387	73,308
,, British South Africa	315	354	2,886	2,105	11,371	13,245	103,998	81,716
,, ,, India	160	156	1,376	1,299	7,267	5,135	54,609	47,273
,, Australia	80	9	622	252	5,348	368	36,133	14,498
,, New Zealand	132	67	1,175	830	7,480	3,608	72,201	48,471
Total (including other countries)	1,879	1,782	16,236	14,788	86,076	77,083	734,835	656,117
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,226	1,533	21,018	13,363	11,879	15,088	196,412	132,288
,, British South Africa	1,506	1,564	6,260	8,588	15,247	17,166	78,964	91,466
,, ,, India	167	234	3,540	2,520	2,986	2,509	49,145	38,132
,, Straits Settlements and Malay States	727	1,375	17,976	9,320	7,234	13,533	133,124	81,436
,, Ceylon	260	115	1,923	1,318	2,703	1,718	19,356	13,913
,, Australia	123	12	3,092	633	2,145	268	35,828	11,754
Total (including other countries)	12,058	11,095	111,459	101,140	129,715	123,616	1,196,149	1,117,767
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	445	376	3,987	3,399	14,945	12,199	141,590	111,588
,, Enamelled	108	89	802	700	9,207	7,191	71,519	59,935
CASTINGS, IN THE ROUGH—								
Iron	136	95	1,288	1,895	4,818	3,402	46,809	59,761
Steel	173	144	1,130	1,751	5,682	7,513	44,873	72,693

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK
LIMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
19, ST. VINCENT PLACE, GLASGOW.
ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOREMAN Coremaker desires change; 12 years present position; thoroughly experienced in oil, dry and green sand; own oil-sand mixings, which are giving good results, and can fix piecework prices; Assoc. Member of I.B.F.; age 37.—Box 680, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRYMAN, Manager or Assistant last 18 years, motor cylinders and similar engineering training, commercial experience, actual experience erection and operation cupolas, brass tilting furnaces, stoves and other plant, seeks executive position or as Representative.—Box 1824, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PRACTICAL Iron Moulder (36), thoroughly experienced in cupola practice, loam, dry-sand and green-sand moulding, desires position as Working Foreman or Assistant; 22 years' experience of marine, general engineering and jobbing castings.—Box 674, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THE STANTON IRONWORKS COMPANY, LIMITED, near Nottingham, require the services of:—

(1) Capable Foreman for large Jobbing Foundry, fully experienced in Dry and Green Sand, also Loam Work.

(2) Experienced Foreman for Vertical Dry Sand Pipe Shops.

Only first-class men will be considered.

Apply, stating age, experience, with references, to the Secretary.

WANTED, skilled Metal Pattern Filer, used to plate-moulding methods.—Apply by letter only to THE STERLING MANUFACTURING COMPANY, Davis Street, E.14.

AGENCY.

ADVERTISER, Foundry Expert and old-established well-introduced Agent, seeks capable firm able to supply graphite crucibles for Ennepe-Ruhr district (Germany). Only first-class firm will be considered.—Write to K.Z. 1820, c/o RUDOLF MOSSE, Cologne, Germany.

PATENT.

THE Proprietor of British Patent No. 222890, dated October 6, 1923, relating to "Process for Producing Metallurgical Coke," is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above Patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois.

BUSINESS FOR SALE.

REGISTERED Company with nominal capital, connected with foundry supply trade, together with patents, etc., for sale. Suitable for one who is desirous of entering the foundry-requisite business. Established about 5 years; good reason for selling. Principals only.—Write, Box 678, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

11 ACRES WORKS SITE.
SHEFFIELD.

145,000 Sq. Ft. of SHOPPING,
Compact and Convenient,
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

PUBLICATION.

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1930 edition. Price 42s., bound in cloth.—INDUSTRIAL NEWSPAPERS, LTD., 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

6-FT. "EVANS" CUPOLA, new and unused, never been lined, complete with wind belt, drop bottom, and pipes; £110 loaded (not required owing to rationalisation).—Box 682, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Loam-Grinding Mill, over-driven. Jackman, pan 4 ft. 6 in. dia., iron runners 30 in. dia. x 10 in. wide, gearing and pulleys; also Polishing or Rumbling Barrel by Canning, 1-cwt. capacity; immediate delivery; cheap.—J. T. WILLIAMS & SONS, Engineers, South Bermondsey Station, London, S.E.16.

FOR Sale, 15 Hand-operated Adaptable Moulding Machines in equal-to-new condition, some of them only a few months old. We are selling because of recent installation of power-operated machines.—Apply, Box 684, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

OVERHEAD Runway Traveller, 3-ton, 19-ft. span, R.S. Joist 10 in. x 6 in., with Traversing Lifting Block, on end carriages; all worked from below; suitable for foundry use; immediate delivery.—J. T. WILLIAMS & SONS, Engineers, South Bermondsey Station, London, S.E.16.

ONE No. 78 Osborne Jolt Press Stripping PLATE MOULDING MACHINE.

One No. 1 Size Pneulec Royer SAND MIXER.

Both in first-class condition.

Particulars, apply, AUDLEY ENGINEERING COMPANY, LIMITED, Newport, Shropshire.

THOS. W. WARD, LTD.

Pneumatic Sand Moulding Machine, admit pattern boxes 16 in. x 16 in. x 6 in.

"Ever-ready" Electric Table Surface Grinders, 14-in. and 20-in. dia. wheels.

"Ever-ready" Electric Finisher, floor type, size 30 in. x 8 in.

24-h.p. Vertical ALLEY & MACLELLAN Steam Engine.

24-in. x 13-in. "HADFIELD" SOLID STEEL BODY STONE-BREAKER, manganese steel jaws.

About 150-ton-capacity STEEL-BUILT STORAGE HOPPER, having 5 compartments.

One 20-n.h.p. PORTABLE STEAM ENGINE AND BOILER.

FOUNDRY LADLES, various types and sizes.

About 3,500 ft. of New slightly stock-rusty 1½-in. dia. Screwed and Socketed Piping in the usual long random lengths.

(ASK FOR "ALBION" MACHINERY CATALOGUE.)

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued.*

WANTED, good Secondhand Sand Hopper, about 2 to 3 tons capacity, for mounting over moulding machines.—Details to THE STERLING MANUFACTURING COMPANY, Davis Street, E.14.

SAND MIXERS.—New and Secondhand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

CUPOLA, 28 ft. 0 in. high, 4 ft. 0 in. dia., complete with air-belt, in good condition; sale cheap; also Blower.—Box 672, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

'Phone **98** Staines.

25-N.H.P. Loco. type BOILER by Robey, 120 lbs. w.p.

35-h.p. Vertical CRUDE OIL ENGINE by Petter.

HARRY H. GARDAM & CO., LIMITED.
STAINES.

MISCELLANEOUS.

GANISTER, best quality for cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

PERFORATED Tin Stud-Chaplets, Riddles and Sieves; Steel-wire Brushes, all kinds. We make these ourselves, and orders therefore executed without delay. Latest reduced prices and carriage paid.—WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

PATTERNS.—Inferior Patterns make trouble in the foundry. Why not buy the best—they cost very little more.—Send to FURMSTON & LAWLOR, Letchworth, Herts.

"PURIC" Cupola Flux in block form cleanses and desulphurises all cupola mixtures. No increase in cost of mixtures, but an actual saving is obtained owing to the production of better metal and owing to less wear on the furnace linings. "Puric" is also supplied for use in the melting of Brass and Bronze, and is undoubtedly the most satisfactory medium for effectively cleansing molten Copper Alloys.

Over 600 foundries have testified to the advantages of using "Puric." Send for a trial cwt.

Write BEECROFT & PARTNERS, LIMITED, the Foundry Chemists, Retort Works, Mappin Street, Sheffield, Foundry Consultants and Advisors, Metallurgical Chemists. Analysis and Testing carried out at low rates at The Laboratories, St. Peter's Close, Sheffield. Write for a copy of "The Foundry Times and Topics," sent post free quarterly.

'Phone: 287 SLOUGH

MOULDING MACHINES

1 "Coventry" headram squeezer, new	£22
2 Britannia No. 1 jolters, each	£36
1 Macdonald 24"×20" electric turnover	£40
1 Macdonald 24"×20" pneumatic turnover	£40
1 "Grimes" 36"×24" pneumatic turnover	£40
1 "Tabor" 40"×30" "Shockless" turnover	£130
1 "Tabor" 50"×42" "Shockless" plain jolt	£70
1 "Shockless" 72"×60" plain jolter	£90
4 Adaptable machines, standard type	£14

PLEASE NOTE PRICES!

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH